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Managing Emerging Technology: Case Studies in Document Imaging Systems

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MANAGING EMERGING TECHNOLOGY:
CASE STUDIES IN
DOCUMENT IMAGING SYSTEMS

by

RICHARD KEVIN BROWN

B.S., Toccoa Falls College, 1982

A thesis submitted to the

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Managing Emerging Technology: Case Studies in Document Imaging Systems

Thesis directed by Assistant Professor James C. Brancheau

Document imaging technology is enabling organizations to handle their information more efficiently than in the past. However, organizations face many issues while implementing this technology. Six case studies of organizations which appraised Document Imaging Systems (DIS) are presented and detailed.

The research had two thrusts. The first aimed to identify critical management issues relating to the successful assimilation of DIS. Actions identified included ensuring integration into the existing technical architecture, designing adequate image distribution channels, preparing for future technology changes, choosing the right applications to implement, selecting appropriate indexes, overhauling the work process, alleviating the concerns of the users, securing adequate management support, and justifying the technology.

The second goal sought to examine how organizations implementing document imaging technology

progress through six stages of technology assimilation: Awareness/Observation, Evaluation/Justification, Acquisition/Installation/Modification, Pilot Test/ Experiment, Limited Production, and Full Production. Research showed that the firms generally cycled through the stages sequentially. However, there was also a significant amount of movement back and forth, revisiting stages through which the organization had previously passed, for example moving from Pilot stage back to the Acquisition stage. None of the organizations had reached the Full Production stage, implementing image processing to its fullest anticipated extent.

Though firms experienced problems during the assimilation of the technology, they all had future expansion plans in technology and/or applications. The firms which implemented document imaging technology have enjoyed many benefits, among which are increased production efficiency, manpower savings, cost reductions, and control of documents.

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CHAPTER I

INTRODUCTION

Document imaging technology is enabling today's organizations to handle their information much more efficiently than in the past. For the 1990's this is crucial. Studies by Huber (1984) and Straub and Wetherbe (1989) predict that organizations in the 1990s will be under enormous pressure to handle information efficiently and effectively.

Nevertheless, an estimated 1.3 trillion paper-based documents reside in U.S. offices. With American business generating each day some 600 million pages of computer printout, 234 million pages from copiers, 76 million letters and 21 million other types of documents, paper and its associated inefficiencies abound. From another perspective, an estimated 95% of stored corporate information resides on paper while only 2% can be found in electronic media (Akers, 1990). Because of the inefficiencies of paper, such as searching for a document, copying, misplacing and even losing documents, leading edge organizations have been and will continue

to look for ways to improve their handling of paper-based information.

A document imaging system (DIS) digitizes paper-based information, such as graphics and text, into images for storage, maintenance and retrieval. This technology promises and, in many cases of actual DIS implementation, has delivered many benefits to organizations.

Organizations generally face numerous obstacles when implementing new technologies. These may be a lack of support by senior management, high-level political roadblocks, insufficient allocation of resources to the project, lack of a clearly defined business application, user resistance, mid-level political roadblocks, underdeveloped technology, and technology costs. By identifying these DIS implementation obstacles and their respective management actions to remove these barriers, it is possible to reduce the risk to an organization and enhance implementation efforts.

The Purpose and Scope of the Research

This research is aimed primarily at identifying the critical management issues with respect to successful organizational assimilation of DIS. Research by Information Systems (IS) specialists such as Nolan

(1979), McKenney and McFarlan (1982), Cash and McLeod (1985), and Brancheau and Wetherbe (1989), hypothesize that managers can positively influence the adoption of new technology by taking specific actions. This research aims to identify those actions which are common to firms which have implemented DIS.

Constructing a phase-based framework for these management actions in the DIS technology assimilation process is a secondary research goal. The Technology Assimilation model described in Chapter III is the foundation for this analysis. These patterns of common managerial actions for those organizations successfully implementing DIS may provide future implementers and researchers guidelines for their own work.

The Approach of the Research

Case studies of six companies formed the basis for this research. The case study method suits the research problem, focusing on current implementations of DIS without exerting control over the behavior of those involved. These case studies were conducted on site or via telephone interviews. Chapter IV details the research methodology.

Seven sections comprise each case study. The Chronology of Events recounts the main events concerning

the firm's implementation of DIS. The Push for DIS identifies the most critical factors considered in deciding whether or not to utilize DIS. In The Role of IS, the part that the information systems department played in the implementation is discussed. Under the Perceived Benefits and Perceived Risks sections, interviewees specify both the benefits which interested the firm in DIS and the associated risks considered in its implementation. In Prospects for the Future, the organization's potential future applications for this new technology are discussed. The seventh section, Evaluation of Implementation, evaluates the organization's success or potential for success, depending upon what stage of technology assimilation the organization was in at the time of the study.

The Organization of the Thesis

Following this introductory chapter are six chapters. Chapters II and III survey the literature and glean what has already been discovered concerning DIS. Chapter II describes DIS, discussing where it fits in the business environment, its functions and associated technologies, benefits resulting from use of DIS, and the critical issues behind its implementation and assimilation. Chapter III develops the foundation for

understanding how organizations implement new DIS technology. It focuses on organizational actions affecting both people and new technology. Here, the Technological Assimilation model is also explained.

The last four chapters of the thesis concern the field research accomplished in this undertaking. Chapter IV describes the research methodology, including factors used to determine participants, survey method, and case reporting. Chapter V reveals the results of each of the case studies, breaking each case into the aforementioned seven sections. Chapter VI analyzes the results of the case studies. It summarizes discoveries concerning the stages of technology assimilation as well as highlighting the primary management issues. Chapter VII finishes the thesis with a summary and conclusions.

CHAPTER II

DOCUMENT IMAGING SYSTEMS

A document imaging system is a specialized system of hardware and software which functions to replace paper documents and files with digitized images of the original. Typically, a DIS converts paper documents into bit-mapped files using a digital scanner. The DIS stores these files in its large secondary storage, most often comprised of optical disks. System users can then retrieve any document, displaying it on a high resolution monitor or printing it on a high resolution printer.

DIS in the Business Environment

Before examining the system requirements in more detail, an understanding of where it fits in business environment will be helpful.

Because DIS seeks to replace paper documents, a definition of *documents* is useful. Theodor Nelson, famous for coining the term 'hypertext,' defines document as "a package of writing or other information (pictures, poetry, facts or whatever) that somebody has

created as a unit. It is a document because someone says it is" (McNurlin 1989a, 4-5). Typically, it has a single author, group, or authority who is responsible for it. Its identity is critical--who made the document, what they call it, and the assurance that it has remained intact .

In today's world documents exist in a multitude of physical realms. The principal realm is paper. A second is the electronic form where the content cannot be manipulated. A third domain includes documents in electronic form where the information can be changed (McNurlin 1989a). Document imaging systems deal with documents in the second class.

Two management disciplines possess key roles in using DIS. One of these is the Information Resource management arena. Those who manage the information resources for a business break down stored, nonpaper-based information into four categories: traditional micrographics, computer assisted retrieval, computer-output microfilm, and electronic image management (EIM). (EIM is their name for DIS.) Here, document imaging technology is seen as competing with micrographics, replacing it as a medium for the storage of documents.

Those managers from the Information Systems discipline generally see DIS differently. In viewing

how data is stored in the computing environment, electronic information can be classified into two basic categories: coded and uncoded. Coded information is representational or symbolic. For example, ASCII and EBCDIC codes use 7 and 8 bits respectively to store a character of information. Coded information can further be broken down into structured (e.g. data base files) and unstructured types (word processing files). Image technology, as well as graphs and drawing systems, utilize uncoded information, data without symbolic meaning. Leonardo Felcian explains,

> Image translation is achieved by line by line bit-mapped scanning in a manner similar to that used in producing a TV picture, with resolution sufficient to maintain the information carried by the page. After choosing a gray border, every picture element (pixel) can be translated into a 0 or 1 bit. The general accepted standards of the scanning process requires a resolution on the order of 200 points per inch" (1988, 29).

A typical compressed page is stored, using a compression algorithm, in a 20-50Kb file. An average word processing file of coded information of the same length is only 2Kb.

Having discovered the place of DIS in the business environment, it is useful to examine the functions performed by the typical system and its associated component technologies. This allows for a

deeper understanding of the issues with which managers will deal as they implement DIS.

The Functions and Technologies of DIS

Four major functions describe how a document imaging system works: document capture, document processing, document transmission, and document storage.

Images are input into the system through the data capture process. To capture image data, a system typically uses a digital raster scanner which inspects a very large number of points, from four million to fifteen million per page, and records these as ones or zeros in a bit-mapped file. Normal resolution for the scanning process is 300 dots per inch. The user then views the image on a special monitor; if it is correct, the user stores it in a compressed form in the storage sub-system. Other capture technologies utilized by DIS include optical character recognition systems and facsimile machines.

After the document is scanned, the image is compressed. Compression is needed because of the large size of the image files as noted above. This compression represents the first of several document processing actions. Document imaging systems require distributed computing power to handle such large

volumes. Robert Castle of FileNet reports that it is needed throughout the system: at document entry stations to compress the data, at workstations to decompress the images, at printers to decompress images and at servers to shorten access time (McNurlin 1989b).

Document transfer is the third major function accomplished by the DIS. The telecommunications system used to transfer the image files is critical. With such large files, up to 100KB of compressed data per image, too many images on the network can quickly clog its throughput. Today's goliath systems process 40,000 images with some scanning 25 pages per minute (McNurlin 1989b). To network the workstations, both Ethernets and Token Ring local area networks capable of up to 10 Mbps have been implemented. Some organizations, such as USAA, an insurance company based in San-Antonio, utilize multiple LANs for image applications (Fisher 1989a). The system deployed by the Texas State Board of Insurance uses nine Ethernet LANs connected through routers to a token-passing ProNet-80 fiber-optic backbone (Black 1990). Another firm, GE-Power Generation of Schenectady, New York, utilizes an image gateway (a high performance multiport switch), an image controller at each remote location, and communications media consisting of twisted pair cable, 9,600-baud

analog, and T1 1.544-megabit digital circuits (Kniskern 1990).

For applications outside the local area, 56kbps and T-1 lines are generally needed. Other systems are too slow; for example, a 9600 bps dial-up line would require over 15 minutes to transmit a 20 page file at an average of 75K bytes per page.

The document storage function is one of the most visible distinctions of a DIS. Advances in the related hardware and a corresponding decrease in prices have enabled imaging technology to become reality. The hardware of a DIS is comprised of several groups of relatively advanced computer technology. At the heart of DIS is the storage technology, for a page of image information is at least ten and up to 50 times the size of an equivalent word processing file. Systems typically utilize an optical technology known as WORM (Write Once Read Many), although compact disks and rewritable disks can also be used.

Commonly used WORM disks are 5.25 inch and 12 inch disks, respectively holding about 5,000 and 25,000 pages of image information per side. These disks can be housed in a jukebox configuration, storing the equivalent of millions of paper pages. An optical disk drive jukebox, similar to a record jukebox, handles up

to 64 disks with an average time for mount/demount of about a half of a minute (Felician 1988). Newer systems can hold up to 150 14-inch optical disks, each containing 6.8 Gbytes. This is equal to over 1000 Gbytes of information--over a Terabyte. Other newer systems use 12-inch optical disk drives capable of 3.9 Gbytes with a transfer rate of 723Kbytes/second.

Another technology, Compact Disks--Read Only Memory (CD-ROM) technology, has much greater storage capacity, up to 10,000 images on 4.72 inch disks. However, users receive these disks already recorded--the user cannot write to it. This technology is useful with information that is up-to-date for a reasonably extended period of time and is currently logistically expensive.

In the coming decade rewritable optical disk technology will be emerging in business applications.

A variety of platforms support image systems. Early imaging systems were standalone; the trend today is toward integrating DIS with existing information systems. Systems have been implemented using PCs, minis, and mainframes. Aetna Life and Casualty Company, Hartford, Connecticut is running a mortgage and loan prototype using a local area network of Intel 80386 microcomputers. In contrast, San Antonio-based USAA

utilizes two IBM 3090s and a 4381 in conjunction with application software (Moran 1988).

In 1984 Wang released the Professional Image Computer (PIC), a system containing the features of Wang's microcomputer but with the additional capability of digitizing images in a matter of seconds. Other vendors now offer conversion packages for PCs with hard disks. The conversion of a microcomputer requires additional memory to handle the large image file, a scanner, and a conversion card. Low speed constitutes the major limitation for these smaller systems. For example, the processor may handle a medium-resolution image of 500 Kbits of data, the equivalent of almost thirty pages of text. It may take up to 30 seconds merely to scan the image.

High resolution monitors form another class of specialized hardware. Today's high resolution PCs display only about 500,000 pixels--800 x 600 points--resulting in medium quality displays. Systems which specify clearer viewing require special monitors displaying 2 million pixels.

Other key components include the data base management system (DBMS) and the associated applications software. The DBMS allows indexing of the documents on high speed, rewritable magnetic storage. The special

DIS application software is key for controlling the flow of information throughout the organization. Managers can make sure that the work is delegated to the right person at the right time. Software can help enforce the optimum sequencing of work as well as reducing the time it takes to transfer information through a business.

Benefits

In this emerging technology, more and more corporations are purchasing DIS because of both tangible and intangible benefits. These include improved worker productivity, competitive advantage, product differentiation, and more satisfied customers. Document imaging processing allows paper-intensive businesses to grapple with the growing mound of paper work flowing into their companies.

Document imaging technology helps organizations operate more efficiently because it addresses paper, that very inefficient communications medium. Bringing to pass an entirely paperless operation will be difficult at best. Organizations are not standardized with respect to forms and formats; smaller ones may have no interest in computerization.

Document imaging technology helps to bridge those gaps. The Butler Cox Foundation highlighted some

potential substantial business-efficiency benefits in using DIS. Document imaging technology addresses the largest portion of information kept by companies, the 66% (1) that could not be computerized because of the legal need to keep paper or a microform image, or (2) for which manual rekeying is uneconomical, or (3) that contains signatures, drawing or pictures that previously could not be captured electronically (McNurlin 1989a).

Efficiency is improved as businesses and government organizations reduce or eliminate misplaced documents and reduce the time it takes to transfer paper-based documents. A DIS can be used to control paper, improve paper flow, and reduce information float time. Information float is the time that information sits around without action being taken on it, i.e., the time it is in the "IN" basket. Document imaging technology has been used to increase the number of customer queries that customer service representatives can handle.

This significant efficiency benefit involves time compression--reducing the time it requires to respond to customers. This brings increased productivity of clerical and customer service personnel. By scanning incoming documents and linking them to their customers' records, customer service representatives can

reduce retrieval time of a record to a couple of minutes and be more accurate in doing so. More productivity can be achieved by integrating the imaging system with other computerized tools, such as electronic mail, word processing and relational database systems.

The time compression of imaging processing can also bring a competitive advantage to corporations. Better customer service differentiates between businesses. Thus, GE-Power Generation has enhanced its customer service operation because of the quick access to data enabled by its system (Kniskern 1990). Time compression also enables businesses to reduce the time required to bring a new product to market. For example, in the pharmaceutical industry a new drug application may require accessing large volumes of paper--up to 30,000 pages. By capturing this data and indexing it using an OCR system, a company may market a new drug two months ahead of its competitors (Moran 1988).

Reduction in storage space, when compared to that required by paper or microfilm, is another benefit. File cabinets occupying large amounts of expensive floor space have been replaced by these electronic file cabinets. The number of copies of documents, each stored in a file cabinet, has also been reduced.

Issues

Though there are many advantages to utilizing document imaging technology, these new systems raise a unique set of issues. What are the roadblocks which might make it difficult for organizations to implement a DIS successfully? For the purpose of this research, these barriers are classified into the following three broad categories: technological, operational and organizational.

Technological

An early issue with which organizations should deal is the suitability of document imaging technology to potential applications. Alternatives may solve the problem more precisely and with lower costs. Depending upon their requirements, organizations should also consider technology such as microfilm, electronic mail, or electronic data interchange.

The distribution of images throughout an organization is a critical issue which must be addressed. This includes both local and long distance telecommunications. Locally, management must answer the question of whether to implement the DIS on the existing network or to run parallel networks. A successful implementation means keeping both the existing users as

well as the new image users satisfied with response times. The network must have sufficient capacity to handle images.

Wide area networks must also be considered for corporations wanting image processing at multiple location. Bandwidth is key. Stephen Munro of International Datacasting Corp, a developer of hybrid satellite networks for FileNet and Wang systems says,

> The factors influencing the chosen communications approach should be the applications, whether they are batch or interactive, the volume of the documents, and the system topology; whether it's point to point, multipoint to point, point to multipoint [long haul, short haul] symmetrical or asymmetrical" (Fisher 1989a, 24).

A second technological issue deals with the integration of the DIS into IS architecture. As noted in the system requirements section, there is a considerable difference between a PC and an image monitor device. Both the PC memory and the display must be upgraded to handle the large bit-mapped image files. Furthermore, advances in the hardware utilized in scanning and storing the data are constantly improving document imaging technology. Changes in technology affect the timing of adoption. The high price of the technology will mean that once a company invests in equipment, it may be soon outdated by faster and more

capable technology. However, the decision not to invest may mean a loss in competitiveness.

Early technology lacked industry standards. Products from the major players such as Wang, FileNet, Kodak, and IBM were incompatible. Recently, however, Wang, IBM, and Kodak have undertaken measures which would open up existing applications for imaging. For example, Wang's Open/Image architecture will allow independent software vendors to develop Wang-compatible image applications for microcomputers and LANS (Bozman 1989).

Operational

Management must consider the time and cost required for the back-file conversion of paper records into digitally stored data. The cost of scanning and indexing one side of a document runs about 28 cents (McNurlin 1989b). With such a high cost, it becomes imperative that an organization critically analyze the extent of conversion--what information is needed, what is the quality of the input, and how many paper records should be scanned.

An expensive part of the conversion process is indexing, that function which labels the images for the purpose of retrieving them. This is key to an effective system because these indexes become the means of

recalling the stored data. Typically, indexing is done either manually or automatically through optical character recognition software. The latter method falls short due to its limited ability to read various fonts or point sizes. Other cost components considered in the conversion process include the condition of the paper documents and whether documents can be fed automatically into scanners.

The issue of which applications to automate must be addressed. Some applications fit better than others in the DIS environment. Castle advises that high leverage document image applications--those providing significant savings--should be implemented first (McNurlin 1989b). Choosing a trivial function for the first test of DIS will doom the project. This is easy to understand when organizations consider the cost--the simplest of systems cost between $30,000 and $50,000, while large systems can cost several million dollars. Because of this cost, management must select projects which justify the expenditures. These projects typically involve a lot of paper, but there are other considerations which managers must evaluate. Management needs to select a pilot application which enables a successful implementation of the technology.

Wick Keating has documented criteria for locating the appropriate DIS applications (1989). Less expensive forms of automation, such as electronic data interchange, electronic mail, and keying in data have replaced paper already. Imaging technologies work well for situations where the information cannot be coded, such as drawings, handwritten information and signatures.

Another characteristic of a potential high payoff application is the frequent accessing and retrieving of documents. For applications requiring numerous customer inquiries, where many people must have access to the same information, or where there are many documents stored in a file, document imaging systems process the data quickly and reliably. This reduces the processing time caused by locating, copying, and distributing the documents.

Complicated processing lends itself to imaging better than simple processing. When processes involve multiple documents which multiple people must review in some specific order, imaging can offer major efficiencies.

Another issue critical to implementation centers around how businesses operate. Business processes typically need to be redesigned to realize

fully the benefits in utilizing the new system. It is not enough just to automate old ways. Whitney Minkler, vice president and co-founder of MSTC, a firm emphasizing information feasibility and implementation studies, writes, "To depend totally on a current structured analysis as a method to remove paper and replace it with digital image hardware is unwise" (1988, 3). Steve Elliot of Andersen Consulting agrees,

> "You have to take a serious look at the work and restructure it. You really do have to get in there and understand. . .why the documents flow the way they do" (Klonstadt 1990, 43).

The best results come when business processes are redesigned to take full advantage of the technology.

Later in the life cycle of an image system maintaining a memory of what has transpired in the organization is important. Procedures for saving and destroying electronic documents are important. Tora Bikson of the Rand Corporation offers this,

> Management should want to know: (1) what documents are being saved that the organization wants to keep, (2) what documents are being saved that should be discarded, (3) what documents are being discarded that should be saved, and (4) which version of the document is 'official' (McNurlin 1989b, 6).

Organizational

Because document image processing is not central data processing, the origins for implementing

imaging systems typically have been outside the realm of the IS department. As in departmental computing, line and functional areas have been predominantly responsible. These functions often have volumes of paper. What then is the role of IS with respect to document imaging processing?

John Connell, executive director of the Office Technology Research Group, Pasadena, CA, thinks that since this technology is not central data processing, IS executives should not seek to control but to guide its use (McNurlin 1989b). IS managers do not consider this an area they will want to centralize or will be able to centralize.

This approach is similar to the IS approach to end-user computing. IS should become the technical experts and scouts for the business; they should advocate the technology; and, they should encourage self-sufficiency.

As guides, the IS department should ensure that the users have an adequate infrastructure. In providing an infrastructure, the IS management should ensure that it includes network links capable of carrying the images, workstations powerful enough to display high-resolution graphics, large capacity storage devices, and standards for the different forms of data.

Another concern is the lack of knowledge and experience with imaging technology across most organizations. With only 1,300 (approximate) document imaging systems installed in the U.S. at the end of 1989 (Klonstadt 1990), the resulting knowledge barrier concerning image-based technology is large. Due to the differences in the technology between DIS and standard data processing, roadblocks arise from a lack of image-related skills.

Thorton May, the director of imaging research at Norton Nolan Institute, advises management to create a knowledge base about imaging. Management should plan and guide the organization in using document imaging technology. Therefore, the organization should build a database of knowledge about DIS (1989).

There are unresolved legal concerns with respect to images. Will documents stored in image files be admitted legally as evidence? This question addresses which functions in an organization may be image processed. Only nonrevisable documents can become legal replacements for paper. The rules of evidence, and in particular the Business Records Exception to Hearsay Rule, state that if a document (paper or microfilm) is used in the regular course of business, then there is a certain circumstantial probability that

it's trustworthy. Therefore, it can be admitted as evidence.

John Connell states that image processing addresses the two main legal concerns for replacing paper with automation--images cannot be manipulated and, in most cases, cannot be erased (McNurlin 1989a). Bob Williams, president of Cohasset Associates, a records management consultancy in Chicago states, "There are laws today that can provide the legal foundation for the admissibility of optically stored information in all fifty states and at the federal level" (Fisher 1989b, 20).

Since document imaging technology is capable of transforming how an organization does business, it can also change the nature of jobs within the organization. Implementers of this technology have to contend with political and social issues. Change must be welcomed by the end users. Once implemented, more uses for the system should be sought; once again, user involvement in exploring and conceptualizing new ways in which the technology can be applied is important. The user must be also educated; training is important.

Another issue is convincing managers, who often want quick tangible results, to invest in this costly technology. However, in some applications, where the

focus of the benefits may be in customer service, the real values may appear only over time. To counter this Thorton May writes, "Create an audience/develop executive sponsors" (1989, 72). They will be the champions of the technology. Later, May reports that, in a survey carried out by the Norton Nolan Institute, findings show that organizations implementing DIS were not constrained by the traditional cost-containment paradigm. Those rules have no way of accounting for intangibles. Rather, other methods of justifying imaging are used, methods which view technology as integral to the business strategies (1990).

CHAPTER III

TECHNOLOGY ASSIMILATION WITHIN ORGANIZATIONS

This chapter develops the framework for understanding the question, "How does an organization facilitate the implementation of new technology?" Breaking down this question further, the chapter investigates both (1) how organizations decide upon which new technology they will implement (technology assimilation), and (2) what are the managerial actions required for organizations to accomplish in order to maximize its use (IS management). Understanding the answers to these questions is important because it provides the theoretical background for examining management's implementation of document imaging systems and the interpretation of those findings.

Technology, Organizations and People

In seeking the answers to the questions above, it was necessary to narrow the focus because of the large body of literature devoted to understanding the interaction between people, organizations, and technology. It was helpful to establish a framework for

learning how the technology, users of the technology, and organizational units affect each other. The framework for this research was developed by Brancheau. (See Figure 1.)

> "People choose how and to what extent they make use of technology in their work (the technology *adoption* process), while technology may partly determine what and how that work is done. Organizations, viewed as aggregates of individuals and groups, also make use of technology to support their activities (the technology *assimilation* process), while technology may partly determine how the various groups interact and function. Working through their reward system (among other means), organizations also influence the individual choices of people (employees) regarding technology use (the managerial action process. Conversely, individuals may influence the organization by demanding resources in support of adoption (Oliverio and Brancheau 1989, v)

In narrowing the subject, the researcher chose to emphasize the Assimilation and Action sides of the model. These were chosen because they were believed to be most relevant to DIS technology. The Adoption side is most relevant to individuals within the system when the members of the organization have the option to adopt or reject an innovation on an individual basis. With DIS technology there is less freedom of choice for use of the system by individual users (Adoption issues).

Everett Rogers (1983), in his classical work on innovation diffusion theory, stated that the innovations can be adopted or rejected by individual member of the social system or by the entire social system. Rogers

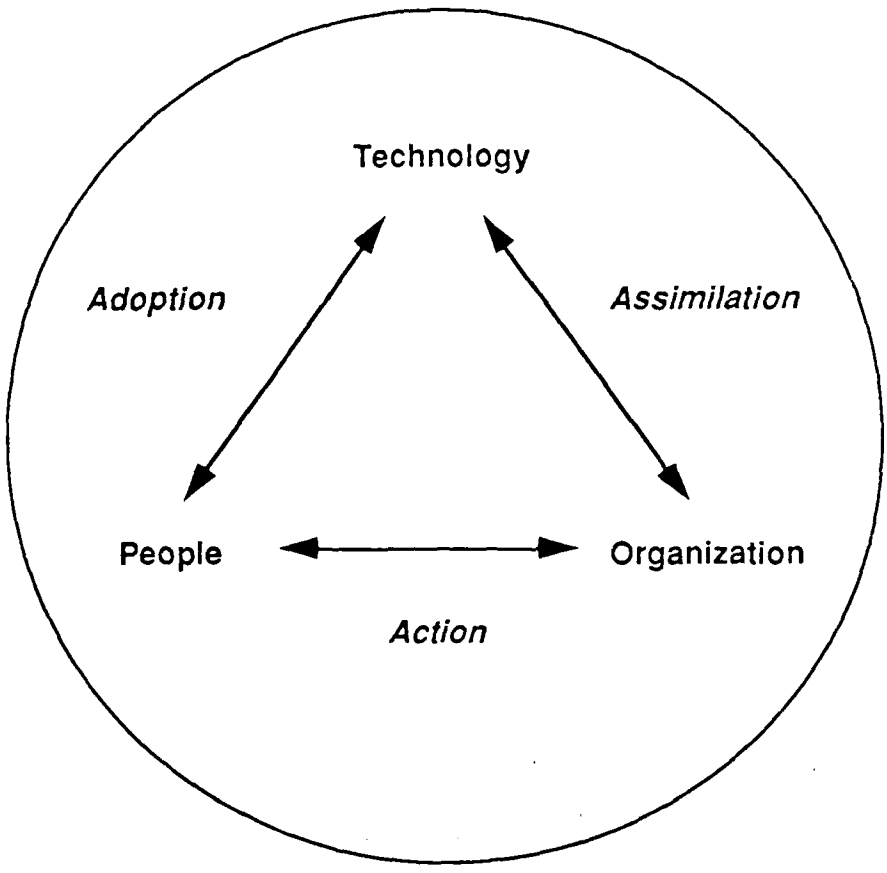

Figure 1. Adoption and Assimilation Model

classifies the decisions to adopt into four categories: optional innovation-decisions, collective innovation-decisions (such as by vote), authoritative innovation-decisions and contingent innovation-decisions. With DIS, the high cost involved and the probable redesign of the work process argue for authoritative innovation-decisions. The freedom of choice to use the system is practically nonexistent once the system is implemented. Hence, individual adoption issues become less important.

Assimilation

Assimilation addresses how an organization incorporates new technology. Meyer and Goes (1988, 897) defined assimilation as:

> an organizational process that (1) is set in motion when individual organizational members first hear of an innovation's development, (2) can lead to the acquisition of the innovation, and (3) sometimes comes to fruition in the innovation's full acceptance, utilization, and institutionalism.

This definition indicates that assimilation is normally described in steps or stages. It emphasizes learning about an innovation, evaluating and choosing the innovation, and the possible full integration of the innovation into the organization.

Stage theory is not new to IS. Before describing the assimilation model followed in this

research, a review of existing research was conducted. In Everett Rogers' work, The Diffusion of Innovations, (1983, 10) he described a general model to explain "the process by which (1) an innovation (2) is communicated through certain channels (3) over time (4) among members of a social system." He went on to hypothesize five stages in which this process occurs: knowledge, persuasion, decision, implementation, and confirmation. The focus of Rogers' work centered on the Adoption side of the research model.

Richard Nolan (1979) outlined six stages of growth through which firms typically progress. By using changes in the IS budget as indicators, he hypothesized that an organization moves through the stages of initiation, contagion, control, integration, data administration, and maturity in assimilating technology.

More recently, McKenney and McFarlan (1982, 113) visualized a four stage model for managing the assimilation of new technology. These stages are "(1) investment or project initiation, (2) technology learning and adaptation, (3) management control, and (4) widespread technology transfer". In this way an organization would be able to balance the spread of the technology between uncontrolled, unhealthy growth, and stagnated growth.

In Phase One, management decides to invest in a new information technology and incorporates a pilot program as well as user training. In the second phase the organization learns how to utilize the technology for tasks other than the first ones. Managers seek to develop and refine a deeper understanding of this technology. During the third phase, as the technology continues evolving, management wants to ensure that the new applications are more cost efficient than the first. The organization strives to develop precise controls to guide it during design and implementation. From here, the organization should enter the fourth phase, characterized by a broad-based communication and spread of the technology to other parts of the organization. However, if cost-efficiency controls of phase three become so tight that they inhibit profitable diffusion of the technology, stagnation can also occur.

During any phase, stagnation may stifle the assimilation process. During the first phase, stagnation generally results from a disaster which causes the organization to see only increased work and few benefits. Here, poor project management, large-scale technical problems, or a poor choice of hardware are typical problems. In phase two, a failure to learn new ways of implementing the technology stagnates its

continued growth. The use of technology is narrow compared to its potential. During the third stage, too much control stifles the spread of the technology.

An organization may be in several phases at any given time with respect to all the technologies it is using. Management must approach technologies in different phases in different ways.

This approach of McKenney and McFarlan addresses the Action side of Brancheau's Adoption and Assimilation model.

Technology Assimilation Model

The Assimilation Side of the model has also been researched by information specialists. Huff and Monro (1985) isolated four ways by which organizations assess and assimilate information technologies. These paradigms originate in the mechanisms organizations use to emphasize technologies and issues. These paradigms are known as the issue driven model, the technology driven model, the opportunistic model, and the normative ideal model.

In the issue driven model, issues which emerge from corporate and systems planning processes drive the search for solutions. This is a top-down approach because the starting point is with senior management and

works down into more detailed analysis by lower organizational levels. The ability to search for specific issues or problems is crucial because only then are the related technologies identified. The search for high-level sponsorship is less important; the planning cycle naturally produces it. This model is based on a problem looking for an answer.

The technology driven model can be described as solutions looking for problems. This bottom-up approach requires a thorough scanning of IS information sources and powerful sponsorship to introduce the technology. One important weakness of this approach is that issues often addressed are not central, and hence, important ones may be overlooked.

The opportunistic model uses some planning and some technology scanning which meet midway to match issues and technologies. Key skills include the ability to see broadly, the awareness of the organization's critical issues, and the possession a solid understanding of IS. The need for sponsorship varies with the issues.

The normative ideal model is comprehensive. It scans the realm of available information technology, and it surfaces issues with which the organization must deal. This resource intensive approach maps technology

assessments to organizational needs. Its strength is comprehensiveness with respect to both issues and technologies.

The assimilation model followed in this research describes the stages which companies undergo when introducing new technologies. This model was developed by Dr. James Brancheau, and described by Jane Oliverio (1989). These stages are called Awareness/Observation, Evaluation/Justification, Acquisition/Installation, Pilot Test/Experiment, Limited Production, and Full Production. (See Figure 2.)

The first stage (Awareness/Observation) involves learning about the new technology by key people within an organization. This information comes from a variety of sources: vendor literature, trade journals, professional groups, and others. During the Evaluation/Justification stage the organization performs formal analysis. This may result in a corporate policy statement on the new technology. During this time, sponsors may solicit backing for the new technology using communications channels. In the third stage, the organization contracts for or installs the new technology for modification and testing. In the Pilot Test/Experiment stage the technology is used first for a business application but only as a test. As the

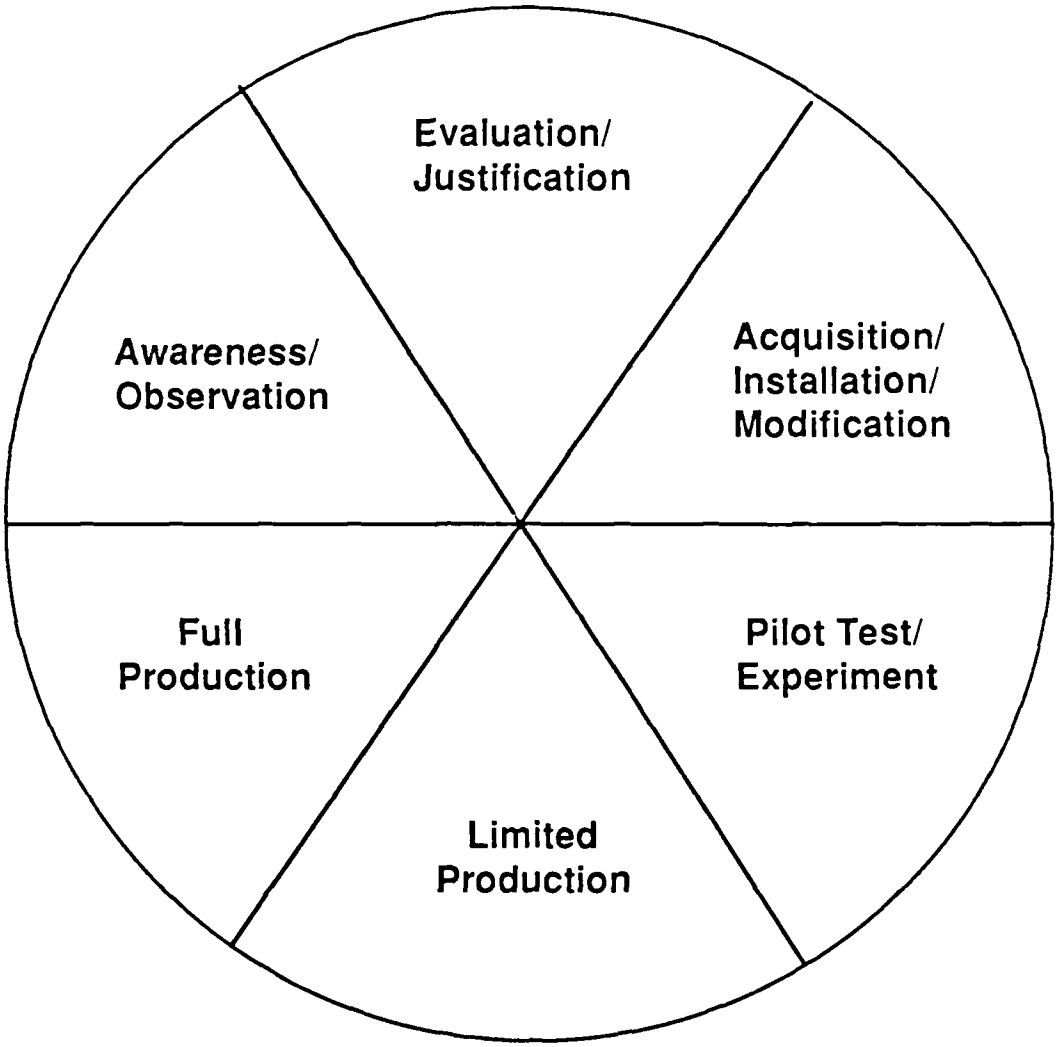

Figure 2. Stages of Technology Assimilation Model

organization finds more uses and routinely utilizes the technology, it enters into the Limited Production stage. The last stage is reached when the now familiar technology permeates throughout the organization to near maximum utilization.

A firm may move back and forth through the cycle as well as moving straight through it. Different technologies may be in different stages. Furthermore, a company may reject the innovation in any stage, thereby terminating its cycle.

In this research, the author wanted to find out if DIS implementation followed the patterns of this model. Other related pieces of information to be analyzed include discovering the key people in the process of a DIS life cycle and uncovering the antecedents of assimilation and the factors influencing acquisition.

Technology Brings Change

Few would argue against the premise that when technology is introduced into an organization, organizational changes occur. Kurt Lewin (1951) in describing the "force-field" theory of change, posited that any behavior is the result of driving and restraining forces reaching an equilibrium. Forces

driving change can include the introduction of new technology along with better raw material, competition from other groups, and supervisor pressure. These drive the equilibrium of performance toward a higher level. Fear of change, group performance norms, member complacency, and well-learned skills comprise the forces which seek to maintain the status quo. These forces equalize to a new level of performance.

In the IS subject area, many have written about organizational changes brought by the introduction of new systems. For example, Dickson and Simmons (1970) described five factors leading to organizational resistance to new IS technology. Their factors are: disruption of established departmental boundaries, disruption of the informal system, specific individual characteristics, the organizational culture, and the manner in which the changes are implemented. These factors resulted in employee behavior characterized by aggression, projection, and avoidance.

Markus (1983) classified the reasons for organizational resistance into three groups.

First, resistance comes from internal factors. Examples of this grouping include: people resist all change; and people with analytic cognitive styles accept systems while intuitive thinkers resist them.

Second, factors within the system or the application cause members to resist. Functionally deficient systems, systems which are not user friendly, and non-ergonomically designed systems are examples of these explanations.

The third theory explains that people or groups resist systems because of interactions between people characteristics and system characteristics. Examples include: organizations with decentralized authority will resist systems which centralize control over data, and systems that change the balance of power in organizations will be resisted by those who lose power and accepted by those who gain it. Different outcomes for the same system in different settings can be easily explained with this theory.

Markus and Robey (1988) expanded this study to categorize the theories explaining the causal relationships between technology and organizational change. Analogous to Markus' earlier classes, these are labeled the technological imperative (technology impacts the organizational structure); the organizational imperative (the organizational processing needs and manager choices drive the information technology); and the emergent perspective. This last perspective "holds that the uses and consequences of information technology

emerge unpredictably from complex social interactions" (1988,589).

This last theory provides managers a foundation for hope in guiding the application of IT in a particular organization. Peter Keen (1985, 463) writes, "If, however, the same technology has different impacts depending on how, where, and when it is applied, then choices do matter." Managers must understand their choices and their likely consequences; their own values and those of the organization; and their duty to make sure that IT supports those values.

CHAPTER IV

RESEARCH METHODOLOGY

This chapter introduces the methods used in the research. It describes the strategy for selecting participants, the survey method, the format for interviewing the participants, and the scheme for analyzing the studies.

Choosing the Participants

The first task was to identify organizations which were in some stage of assimilating document imaging technology. The number of possible organizations from which to choose was limited because of the small base of installed systems. The newness of the technology, its relatively expensive price tag, a general lack of knowledge about document imaging technology, and its place outside mainline data processing all contributed to its limited penetration of the work environment.

A second goal was to seek out companies in the Rocky Mountain region because regional companies could be easily visited for face-to-face interviews. Personal

interviews allow the participants a rich form of communication. For example, reading facial expressions and body language is possible in personal interviews. Also regional organizations were more likely to help in a university project.

Participating organizations were gleaned using the following methods: literature reviews, references from other participants in the research, and personal contacts. The literature review yielded one company within the local area which was assimilating the technology. Personal contacts led to another four firms. One firm from this latter group gave the name of the sixth organization.

The six organizations participating in the research varied in character. They represented organizations from both private and public sectors. Three government agencies were included because they represent 35% of the market (Badler 1989), and they were very willing to participate. (This is most likely a result of not being in the competitive marketplace.) Five of the firms were located in the local area. The organization from outside the area agreed to participate because the researcher works for the same parent organization. Organizations in various stages of the assimilation process were included. Overall, it was

hoped that this cross-section of organizations would reveal many useful insights.

Research Strategy

Several strategies were available for this research. These included surveys, archival analysis, history, and case studies. Case studies were chosen for three reasons. First, the research question was more than a simple who, what, or where type of question. It involved why organizations took particular actions and how they assimilated technology. Second, the research did not require control over behavioral events. That is, the investigator did not seek to control or manipulate the actions of others. Third, the focus was on contemporary events rather than historical events. According to Yin (1989), when the researcher works with these types of characteristics, the preferred method is the case study.

The case study method seemed to fit this application better than the others. Surveys could probably not be designed with enough depth or with enough flexibility to gather the needed data. Archival analysis and history focus on the past. This research needed to capture contemporary events. Case studies

used tools which focused on deriving the needs information.

It was anticipated that some of the organizations, especially those private firms using the technology for strategic advantage, would be concerned about confidentiality. The case study method gave organizations two controls. First, confidentiality was achieved by substituting company and personal names with industry names and titles. This fostered an environment of security and privacy. Second, an organization could ensure confidentiality by limiting the amount of disclosure. This was done by several of the agencies studied.

Survey Method

In this research the principal data gathering tool was the interview. Some of the participants also provided supplementary documentation, such as a request for proposal (RFP) or requirements documentation.

There are various methods for conducting interviews. Yin (1989) describes the following spectrum of methods for conducting interviews: the open-ended interview, the focused interview, and the survey interview. The open-ended interview is the least structured and the survey method is the most structured.

In a similar breakdown of methodologies, David and Chava Nachmias (1981) described the nonscheduled interview, the nonschedule-structured interview, and the schedule-structured interview.

In the nonscheduled interview there is no set of prespecified questions. Rather, the respondents relate their experiences, describe what they think is important, and reveal their attitudes as they deem fit. Though this provides a great deal of freedom for both the respondent and investigator, it would make it more difficult to compare firms.

On the other end of the spectrum is the schedule-structured interview. Here, the questions, their wording, and their sequence are identical. The investigator seeks to control the wording of the questions because different wording might elicit different responses. This format was rejected because it was unnecessarily rigid in its makeup. Both the interviewer and respondents needed to have the freedom to pursue a particular line of questioning. Furthermore, each implementation was expected to vary depending on the type of organization (for example, government versus private), its experience with information technologies, and other factors, making this type of interview unworkable.

In the nonschedule-structured interview the respondents are given freedom to express their understanding of a situation given to them. The respondents are known to have been involved in a particular experience. The interview is based on an interview guide related to the research. It focuses on the subjective experience of the situation under study. This method was chosen in order to allow both the respondent and the researcher their needed freedom. Furthermore, it gave the interviewer the opportunity to clarify inconsistencies, omissions, and misunderstandings encountered along the way.

Although in-person interviews would have been preferable in the case studies, this was impossible because of time and budget constraints. As a result, five on-site interviews and one telephone interview were accomplished.

Interview Format

After the participants had agreed to be involved in the research, each received a letter (Appendix A) confirming the date and time of the interview; an executive summary (Appendix B) describing the nature and extent of the research; an interview guide (Appendix C) listing the questions which would be

covered in the interview; and a follow-up survey (Appendix D) on technology assimilation with a diagram of Brancheau's Technology Assimilation model.

The interviews opened with a discussion on the nature of the organization's business, the role of the interviewee in the organization, and the extent of the organization's DIS efforts. After the opening remarks, the questions centered on five major topics: the history of the acquisition, the role of the IS department, the issues involved with the implementation, the perceived benefits, and the perceived risks.

In relating the history of the acquisition, a chronology of events was established using the Brancheau assimilation model and dates provided by the interviewee. Additional questions probed into areas such as debates and controversies concerning the technology, the users' role in the assimilation process, and the procurement process.

The participants were asked to complete a follow-up survey after the interview. The purpose of the survey was to corroborate the responses of the interviewees. Only three surveys were returned.

Analysis Strategy

Each case study highlighted the most prominent critical success factors for implementing DIS. Additionally, common success factors were grouped together, revealing how some similar actions were taken by more than one firm.

Using Brancheau's Technology Assimilation model as a guide, the analysis also tracked the organization's progress through its stages. This further highlighted some of the important steps the organizations took while assimilating document imaging technology as well as pointing out some of their differences.

CHAPTER V

CASE STUDIES: REPORTS

This chapter describes the six case studies in order of penetration, from the organization with the least to that with the most. The names of the organizations have been replaced by names reflecting their respective industry or governmental sector. The people interviewed are identified by their titles.

It was noted during the interviews that the three private organizations were very concerned about what would be published. These firms agreed to the presentation of the material in the thesis in the manner described. Two were also shown a sample report from the CASE Emerging Technology Project and agreed to having the results published in a similar manner.

First Air Force Agency

This agency within the Air Force is responsible for department-wide accounting functions. These include active duty military pay, retired members pay, and tracking authorizations for the department. As of July 1990, the organization did not have a DIS installation.

The Deputy Chief, Information Processing Division, participated in the case study interview. His duties included management of the center's large computer system and oversight of the data center; he also has an informal role as a technical advisor. Prior to his work with the DIS, he had been responsible for implementing other new technologies within the center, such as robotic tape loading and an upgraded consolidated data center. The communications-computer division operates the largest non-classified IBM shop in the Air Force.

Chronology of Events

The organization first became aware of possible DIS applications in late 1989. Previously, the Deputy Chief had participated in the development of plans identifying how the current information systems support the roles and functions of the agency. Thus, he became very aware of the business processes within the agency as a whole. Upon first learning about document imaging technology, the Deputy Chief, with staff support, researched the literature to uncover DIS capabilities. His original impression was that many of the current manual processes in customer service areas were ideal for DIS applications.

The Deputy Chief also pursued other avenues of research. He contacted vendors and they were able to give product demonstrations. He conducted on-site surveys of current DIS installations; in one case he brought a functional area chief with him to expose the chief to the capabilities offered by DIS applications.

As a result of developing interest in DIS possibilities, an "Integrated Solutions Team" (IST) was formed in March 1990. Its mission was to examine this and other advanced technologies in order to see if they could be utilized in enhancing organizational productivity. The IST reported to another division under the same communications-computer directorate. The director fully backed the IST and provided funding for its research into technology solutions. It was expected that the IST study would result in authorization and appropriations for a DIS.

User involvement and education in the technology assimilation process had already been evident. The Deputy Chief involved prospective users in a field trip while he was exploring the technology. He circulated articles which discussed the new technology. Additionally, the IST involved the users in defining the functional specifications for the system.

A summary of key events is shown in Figure 3.

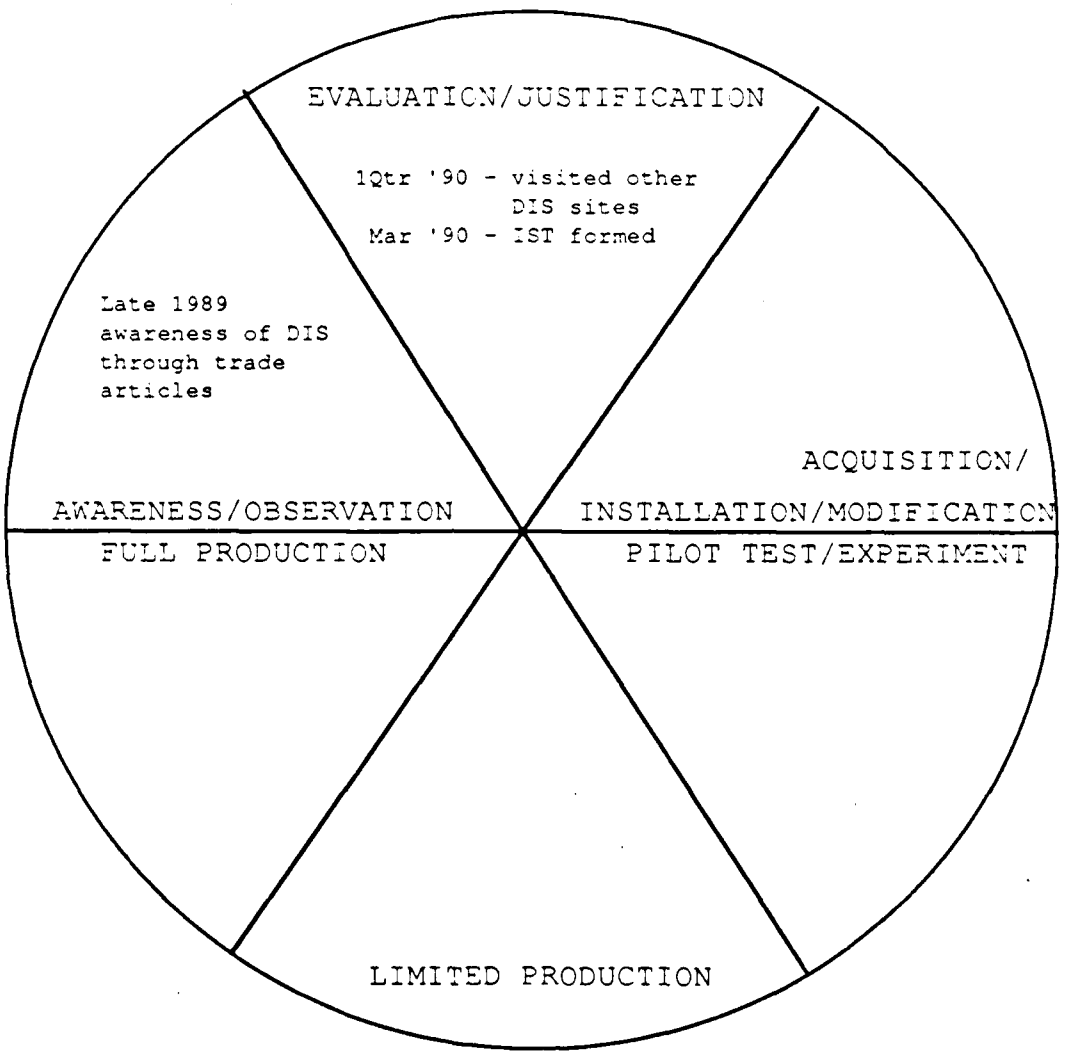

Figure 3. Stages of Technology Assimilation Model
First Air Force Agency

The Push for DIS

There are several drivers for the image solution.

1. The down-sizing and restructuring of the armed forces. The "end of the 'cold war'" at the turn of the decade increased the demand by the civilian sector to down-size the armed forces. As a result, many organizations within the Department of Defense were being realigned and their functions combined. This agency had been identified by a Defense Management Review as one which will take on additional roles in the coming years. Document imaging technology offered the ability to do more tasks with fewer people.

2. The current high cost of records storage and retrieval. One potential DIS application was retired pay. It had approximately 600,000 records and used a jacket system stored at an off-site facility. When a retired military member needed to make a change to his/her record, the record had to be retrieved at a cost of ten dollars.

Participation in the development of the strategic business plans by the Deputy Chief was a key factor in the exploration of possible DIS applications. Because he was aware of the many details of the agency's

methods, he was able to identify possible DIS applications readily.

The Role of IS

The IS department was the primary motivator for this technology. However, controversies recently developed within the agency concerning image responsibility and ownership. The administration directorate, with its records management duties, and the communications-computer directorate, with its data processing responsibilities and its technology team, were vying for ownership. Additionally, as a result of the work by the Deputy Chief and the IST, several functional areas initiated their own investigations into DIS solutions.

Perceived Benefits

The Deputy Chief outlined several potential benefits resulting from implementation of a DIS. Primary on the list was the improvement in productivity. With records available on-line, the customer service representatives would no longer have to wait days for records to be pulled from the storage site located miles away. They would be able to effect the changes immediately, saving processing time. In time,

management hopes to achieve a doubling in the number of accounts its representatives can handle.

Improved customer service is another expected benefit. The customers would be assured that the changes would be made to their records when they had finished talking with the customer service representatives.

Cost reductions in retrieving and accessing records is another expected benefit.

Perceived Risks

The agency faced several problems with respect to DIS implementation. The turf battle for DIS ownership could slow or derail efforts to bring the technology on-board.

The agency foresaw several other problems. Knowledge of image technology capability was low. Most did not know what it is. Others thought it would be the panacea. Therefore, organizational education became important. The agency also faced user resistance. Union members saw the implementation of a DIS as a threat to their employment. When the organization had implemented robotics, some of its people were displaced.

An essential requirement for the DIS was its ease of use. The level of training of the system's potential users was typically low. Therefore, in order

to reduce the risk of user resistance, the system must not be complicated to use.

Legal requirements further complicated DIS implementations. Federal law requires that certain paper records be kept for 50 years after the death of the members. Until the requirement is changed, either through legal precedence or through the legislative process, both paper and images will have to be kept.

In terms of technology, the Deputy Chief saw one basic hurdle: the system would have to have "seamless interactions with existing technologies and applications." Whatever system may be implemented, it will have to interface with the center's existing computer system. The center currently has a broadband LAN: Satisfactory distribution of images along this LAN and its multiplexed sub-LANs will be crucial to success.

Prospects for the Future

In addition to the retired pay application, the IST was investigating other applications. One possible application is the legal department where large case files are tracked. Active duty military pay is another possible application.

Evaluation of the Implementation

This agency rates a medium chance of success; a mixture of signs contribute toward this prediction.

Positive Signs. Strong leadership and experience were evident. The Deputy Chief had already successfully managed two expensive computer system projects in the agency. The Advanced Technology Group (ATG), initiated only this year, had already implemented a voice-messaging system. Additionally, the director of the communications-computer directorate backed the DIS idea. Other factors which could contribute to successful assimilation included high user involvement and on-going education.

Negative Signs. A critical negative sign was sent by the Deputy Chief when he stated that he felt that document imaging was a "solution looking for a problem." If the leadership is intent on implementing a DIS solution, it may do so without adequately ensuring that it has a "DIS problem."

A second problem is the multiple factions within the unit vying for the DIS lead role. Though the communications-computer directorate was well-qualified and had taken the lead to date with respect to DIS, it may not ultimately be responsible for it. This would hurt the agency's chances for success.

Table 1 summarizes the key findings for the first Air Force agency.

Table 1

Key Findings for First Air Force Agency

Benefits
- Better customer service
- Increased productivity
- Decreased costs

Risks
- Worker resistance
- Turf battle
- "Seamless interactions"
- "Solution looking for a problem"

Success Factors
- Strong leadership & support
- High user involvement
- Integration in existing IT architecture
- Changed work process
- On-going education

State Government Department

The state government department in this case study administers both commercial and governmental recording programs for the state. These functions include the registration of all corporations doing business in the state, the registration of all commercial loans (the debtors and any secured and assigned parties), and the administration and enforcement of both election and licensing programs at the state level and within the counties. The Director

of Data Processing (DP) detailed the installation of the DIS. He has been involved in all phases of the installation to date, from awareness through pilot test/experiment.

Chronology of Events

The Director of DP had first learned of document imaging technology prior to a 1985 department-wide IS study. This 1985 study examined the department's need for upgraded computer systems. This came about after detailed discussions with members of the various communities which the department serves and with the members of the state legislature who wanted their constituents to receive faster and more complete service. As a result of the study, in January 1986 the department issued its five year Computer Planning Study. Along with a new mini-computer, which would handle the main data processing functions, a document imaging system with OCR functions was recommended. This system was called the Scanned Document Storage System (SDSS).

In September 1987, after the new main data processing computer was installed, the request for proposals for the imaging system was released to vendors. The RFP specified two scanning processes, the first was OCR, and the second was image. The delay in releasing the RFP was a direct result of the Director of

DP waiting until he felt the technology was mature enough to meet his requirements.

By October 1987 two major imaging vendors had responded to the RFP--FileNet and Plexus. In late December 1987 after reviewing the proposals, the source selection committee had narrowed the field to one company which might meet its stringent requirements--Plexus. Whether or not Plexus would get the bid depended upon satisfactory completion of an on-site demonstration. Two demonstrations at the Plexus facilities in California were necessary to prove to the source selection committee that Plexus had both the technology and the programming skills to complete the tasks. By February 1988 the state had accepted Plexus' bid.

Equipment installation started almost immediately. By April 1988 the state had started scanning some 2.5 million documents which would be its primary database. Two types of documents were stored: those showing the registration of all corporations doing business in the state (termed Corporations filings) and those documents registering all commercial loans (termed Uniform Commercial Code (UCC) filings). Since credibility in its database was critical, the most accurate source for this data had to be utilized. For

UCC filings this proved to be the actual paper source documents. However, in the case of the Corporation filings, this was microfilm or microfiche. These documents required an extra step: They had to be blown back to paper from the microfilm or microfiche and then scanned. This two-step process, combined with checking and double checking the images for accuracy, lengthened the conversion process through June 1990.

In March 1989 Plexus filed for Chapter 11 reorganization. This major problem delayed the project implementation for an entire year. The state office lost valuable time because of the fuzziness created by the bankruptcy. It did not know what its legal rights were in the situation.

Because Plexus was basically an integrator, the state office still had hope. The only piece of Plexus equipment in the system was the XDP 95 central processing unit; everything else was off-the-shelf technology. Once the bankruptcy was settled, the office was able to restructure development and support for the system along three contracts. Grunman Inc. was awarded a contract for hardware maintenance. Harshman Consulting became responsible for the completion of the application software. The newly down-sized Plexus remained custodian for the system software.

At the time of the study, the conversion of the old data into the image data base was complete, and the department was ready to move into its first limited production stage. The software had been completed and awaited installation and testing. A summary of key events is shown in Figure 4.

The Push for DIS

Several issues argued for the DIS. The department's existing computer system had replaced file cabinets ten years before the Computer Planning Study had been released. Each year the number of filings and requests by the public for those filings had increased significantly. For example, in 1983-1984, 26,423 search requests were made to the UCC office. In the following year, the number had grown to 46,340. In addition to the increasing number of requests, more detailed information was being requested.

To meet the increased workload, more staff would have to be added. However, the state legislature did not want to increase the number of employees in the state bureaucracy. Therefore, a state-of-the-art information system, replacing future manpower allocations with machines, looked like a great alternative.

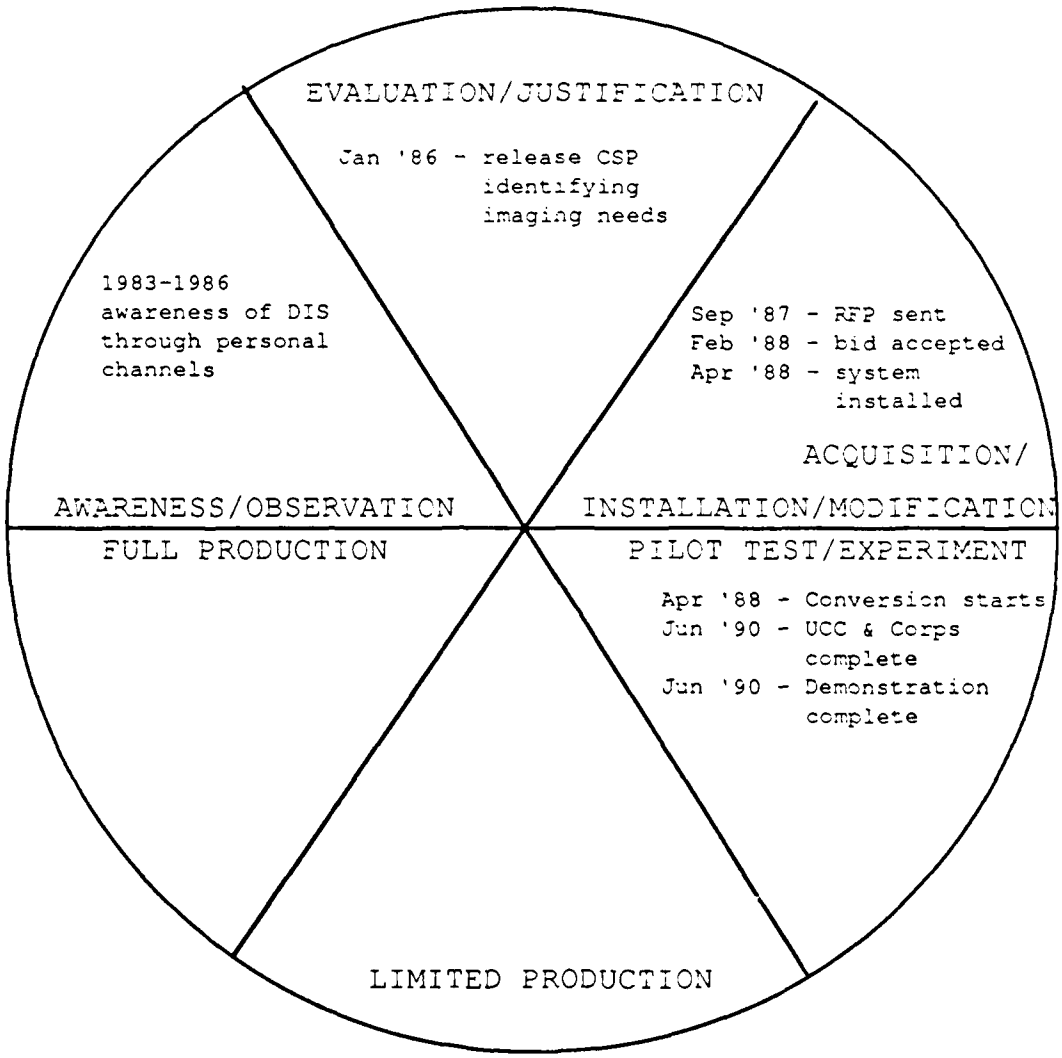

Figure 4. Stages of Technology Assimilation Model
State Government Department

The system described in the RFP was designed to meet the following goals:

1. Replace the microfilm/microfiche process. This old process took 10 days to photograph a roll of film, develop it, splice the processed roll into a jacket for the correct sequence, and then microfiche it.

2. Speed up the search for documents. Prior to imaging, it often took 3-5 days to search manual files for information. Copy searches would be sped up through accessing the SDSS.

3. Reduce much of the data entry process. By using the OCR system in conjunction with the image system, much of the data entry required to index images would be eliminated. The scanners read a cover document which was then sent to the OCR subsystem where the bit-mapped file was converted into an ASCII file. The ASCII data was then used to index the images as well as providing input into the main data processing system.

4. Provide one-day processing for registration of new corporations and UCC lien filings. Documents were scanned into both the main data processing computer and the image unit using the image scanners and the OCR system.

The Role of IS

The role of the Director of Data Processing was central to the implementation of the DIS. The SDSS was part of an overall plan to improve the speed and level of service provided to its customers.

The head of the state department also provided direction for the entire upgrade: She was a strong backer of the system. Because the department was self-supporting, funding itself through fees it charged and not through tax dollars, it lacked the typical legislative battle for dollars. The Joint Budget Committee gave it swift approval.

Perceived Benefits

The business processes which handle corporation registrations and UCC filings were redesigned to shorten the processing time. In fact, the RFP specified the new process. This meant that customers should obtain a registered corporation and a valid, unique name on the same day that they applied.

The Ethernet LAN connecting the system provided fast response time. It was solely dedicated to the SDSS functions. The LAN also connected the SDSS to the main DP computer. This allowed the same terminals to do data

entry and to update the computer files as well as allowing the same index to access both the in-house computer files and image files.

The image system will provide the UCC filings several benefits. The UCC will be immediately available for use, instead of having to wait ten days. Additionally, two data entry operators will be available for other duties. Two or three search people will also be made available for other duties.

There should also be additional manpower savings for the Corporations filings application. The department will avoid hiring two additional people to do data entry for corporate reports. Two more employees may be freed up as information concerning officers and directors becomes available and certificates are printed automatically. Trademarks, agent changes, and reports should be greatly impacted.

Perceived Risks

The redesigned work processes also presented some problems. The Computer Planning Study and the RFP redefined how work would be done within the affected offices. Worker resistance to the new technology followed because workers did not want to change the way they did their jobs. In fact, the redefined processes

and the Director of DP were blamed for causing a heart attack in one worker.

The new process also will make more data available to the communities the department serves. Though the OCR system reduced the required data entry to correcting what was not properly interpreted by the system, the perception of dealing with more data generated resistance. Some of the data entry workers only saw the increase from 350 characters of data to 900 characters.

Some members of the business community objected to the change in procedures. Instead of simply printing or writing the information required by certain forms, they were mandated to type in the information, to be read by the OCR subsystem. (To date, the OCR can read 22,000 different fonts styles and sizes but not handwriting.)

Prospects for the Future

Many more applications were being planned for the image system. The Director of DP targeted applications, such as the annually filed corporation reports, Campaign Reform Act data, registration of lobbyists, and registration of bingo operations for DIS applications. The organization was also developing OCR

capabilities for reading handwriting which would allow voter registration data to be stored in the SDSS.

Evaluation of Implementation

As this agency enters the limited production stage, it has a medium-to-high probability of success. Several factors contribute toward this assessment.

Strong leadership. The Director of DP has a clear focus on where he wants to take computing in the organization. His vision, combined with strong backing from both the department head and legislators, should ensure the success of image processing.

An integrated solution. Though the project faced early obstacles with the vendor's bankruptcy, support was found from other firms. The endeavor's success did not ride on only one possible provider. This could be especially important when dealing with smaller, less-reputable image suppliers.

Other contributors. There were other success factors evident in this DIS implementation. These included a redesigned work process, the assurance of adequate channel size, technological integration with existing systems, and implementation of a well-indexed database.

Table 2 summarizes the key findings for the state government department.

Table 2

Key Findings for State Government Department

Benefits
- Better customer service
- Increased productivity
- Manpower savings

Risks
- Worker resistance
- Business resistance

Success Factors
- Strong leadership and support
- An integrated solution
- Integration into existing IT architecture
- Dedicated distribution channel
- Exhaustive image data base and index
- Changed work process

Second Air Force Agency

This organization acts as the comptroller agency at the department level. Functions include personnel, budgeting, accounting, payroll, and administration. The agency entered the Limited Production stage with respect to document imaging technology in November of 1989, using its system to track vendor payment documents. The Deputy Chief of the IS branch detailed the assimilation process through its present stage. He viewed the implementation from two perspectives: he worked for the contractor responsible

for the LAN installation, and later worked for the Air Force agency in its IS operations.

Chronology of Events

The agency began examining document imaging technology in 1985 as a way of increasing control over misplaced documents. At that time vendor payment documents were tracked using a mainframe application, the Document Control And Tracking System (DCATS), file folders, and microfilm. The IS Chief thought that document imaging technology would help solve control problems.

As a result, the organization explored document imaging technology through several trial systems. In 1987, Summit Technologies provided the first DIS. It was a mouse-driven pilot-test system provided free-of-charge. Its lack of user-friendliness created user resistance: The users were irritated by constantly having to alternate between the keyboard and the mouse.

The agency secured its second trial system in 1988. This time FileNet provided a test system at no cost. This small, single drive (versus a jukebox) system met with less resistance. However, it could not be integrated with the organization's present technology base. It was also very expensive; each

station was outfitted with decompression hardware costing over $4,000.

The third pilot system was engineered and integrated by Harris Lanier and procured on a six-month lease with an option to purchase. It integrated existing microcomputer hardware and Ethernet LAN with the image-unique hardware and software. This system included two optical disks drives and it utilized decompression software, a much less expensive approach than hardware. The system proved a success.

Once the organization had found a system which met its requirements, the IS branch generated its requirements document. The procurement was sole source justified, based on Harris' ability to integrate existing systems and image technology, while providing required functions in a user-friendly manner. The rest of the equipment arrived in the second half of 1989. In November 1989 the organization moved into the Limited Production stage.

This DIS was integrated into a LAN connecting 800 microcomputers of various technologies (8088, 80286 and 80386 systems and all sorts of monitors): At the time of the interview, it served 60 image users. There were 52 80386-based file servers, each interconnecting 32 end users. Unique DIS-related components included a

20-platter Signet jukebox, 300 dpi scanners, 6 scanner stations, seven 15-page-per-minute printers, and decompression software. The microcomputers served as both terminal emulators for the mainframe and image displays. They used only 640 Kbyte of RAM.

Work was redesigned to take advantage of the system's ability to track and retrieve documents. The new process started with creating an electronic file using a log number obtained from DCATS. When related documents were received, these were scanned into the image system and tied together with the log number. These documents were then made available to the technicians who tracked and processed payments to the vendors.

A summary of key events is shown in Figure 5.

The Push for DIS

Legal requirements, plus difficulties in tracking contract payments, combined to drive IS personnel to seek an image solution.

Prompt Payment Act. The Prompt Payment Act required that vendors which provide the government with goods and/or services be paid within certain time intervals. If the government fails to meet these standards, penalties must be paid to the vendor.

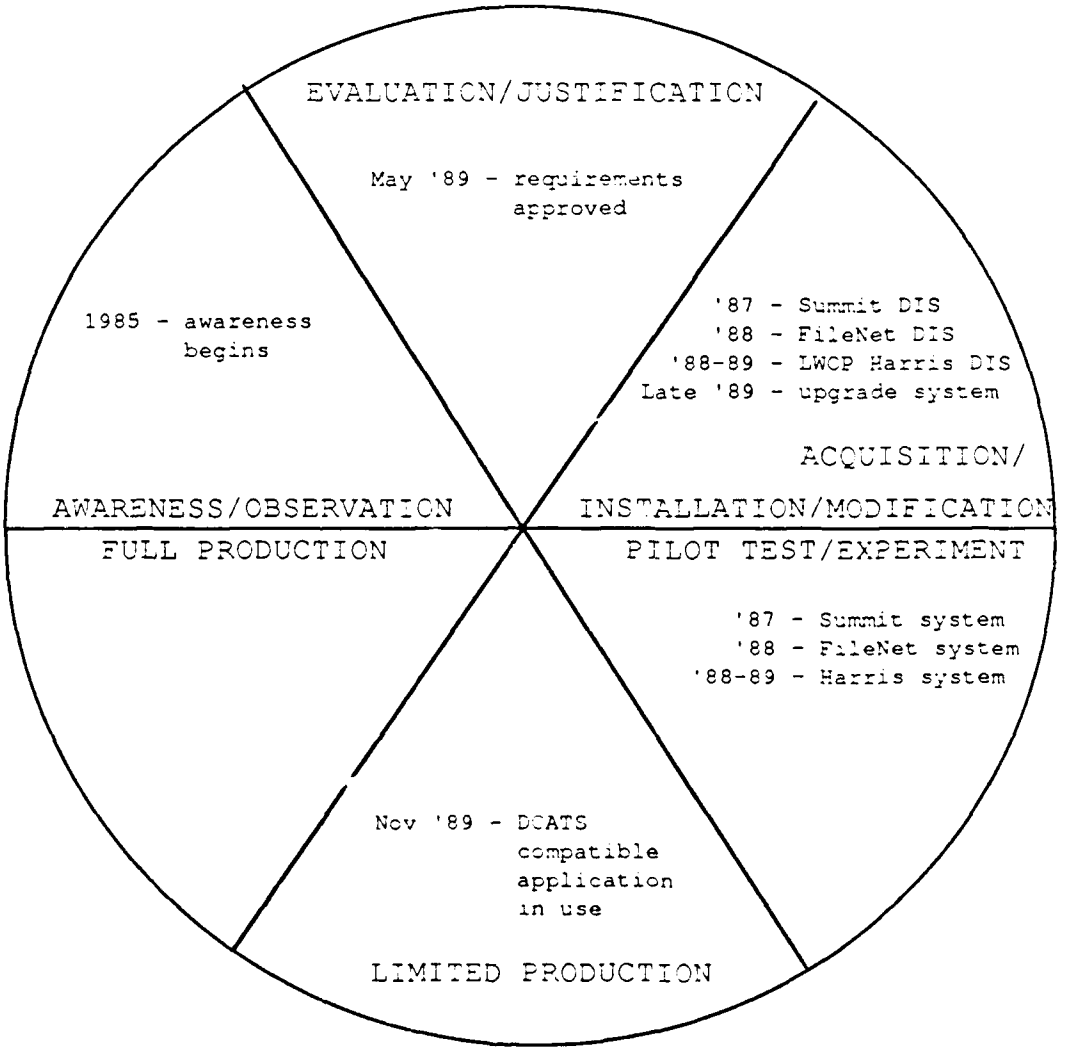

Figure 5. Stages of Technology Assimilation Model
Second Air Force Agency

Lost Documents. The DOD agency tracked payments using a mainframe system, paper files, and a microfilm system. In processing payments, the accounting organization tracked several documents--the purchase request, the requisition report, and the invoice--in a paper file. These files or their individual documents often became lost or misplaced, thereby slowing the payment process and contributing to an unacceptable penalty payment rate. The government was paying significant penalties. Leaders of the organization wanted to find a way to save this money.

The organization had tried to solve this problem earlier by using a microfilm system. This system, purchased by the Air Force for archival functions, failed. It had not been designed for tracking the up-to-date documents required by the comptroller.

The requirements document cost-justified the imaging system by showing a payback in 4.1 years when compared to continuing the microfilming process. It further justified the system by saving overtime hours, improving productivity, and decreasing lost documents.

The Role of IS

The role of IS was crucial to this assimilation. The Chief, Comptroller Information

System, was the source of ideas for the DIS project as well as its main champion. The organization's leadership, anxious to save money, backed the Chief's efforts.

The role of IS continued to be central after implementation. Even before the unit entered into limited production, it was searching for more paper-intensive applications.

Perceived Benefits

Many benefits were seen as a result of DIS implementation. Document control made these possible. With the DIS, it was rare for workers not to find needed files.

This important benefit generated savings in two ways. First, the organization was able to decrease the number of penalty payments significantly. Second, in numerous contracts, early payment brought discounts. Document imaging technology often made these available.

The second major benefit was production efficiency. Originally, the requirements document stated that the DIS would save manpower. This met resistance because, in the era of a down-sized armed forces, most units seek to retain their personnel. After rewording, the benefit was stated as increased productivity. It permitted resources, which had been

involved in filing and retrieving records, to be employed in accomplishing other work not previously accomplished because of limited manpower.

A third benefit was the reduction of paper flowing in the office. Prior to the DIS implementation, at least three copies per work order were generated and many personal copies were typically made. Now, the original is scanned and its image placed immediately on the network. The original is then filed according to federal regulations. No paper copies are made. Workers use the images in the system.

Other benefits followed. One was improved customer service. Vendors appreciated being paid quickly. Another was improved morale; document storage space encroached upon the employees' work areas, creating substandard work conditions. Inadequate office space negatively impacted employee morale and performance. The DIS helped remedy this problem. Morale also improved because penalties were no longer a primary briefing item to upper management, thereby reducing pressure throughout the agency.

Perceived Risks

User resistance was encountered early in the testing cycle. Those implementing the DIS moved effectively to diminish this risk. A training program

was developed. Managers were given the system first in order to acquaint them with the system's capabilities and methodologies. Then the users were instructed on the concepts behind the system and were provided with hands-on training. User-friendliness is crucial.

The DIS required continuous management. As the users grew in their knowledge of the technology, they asked for the ability to index images on more fields. IS personnel were continually required to make software modifications.

A third risk was the degree of technology change within the DIS industry. For example, after the system was originally procured, windows became a popular operating environment. A related risk is the proprietary nature of some DIS technology. Because of these risks IS focused on making the system as generic as possible, depending upon common industry standards. For example, image files were specified as the Group IV fax files. The organization wanted to protect its investment.

Prospects for the Future

The future of the DIS at this organization looks bright. Several more applications are being developed or explored. These include the tracking of civilian personnel records, supply-related standard

forms, and payroll time and attendance sheets, as well as tracking information involved in temporary-duty travel obligations. The organization is currently developing specifications to expand the system with distributed optical storage and OCR indexing capabilities. Finally, a system upgrade being developed utilizes windows to switch between image and mainframe applications. This replaces a hot-key approach which suspends operations when moving between mainframe and DIS applications.

Evaluation of Implementation

The organization's success depended on several factors.

Understanding requirements. The most important success factor was a precise knowledge of its needs. The organization developed this through its use of several pilot systems. As IS tested these, the organization was able to evolve a solid core of specifications. Before investing money, they ascertained their requirements and discovered the best way to achieve them.

Integration into existing systems. This factor was crucial to the agency and they pursued it relentlessly.

Other contributors. Other factors included a redesigned work process, the selection of suitable imaging applications, a strong champion, and effective handling of user resistance.

Table 3 summarizes the key findings for the second Air Force agency.

Table 3

Key Findings for Second Air Force Agency

Benefits
- Better customer service
- Increased productivity
- Decreased costs
- Better document control
- Improved morale

Risks
- Worker resistance
- Need to continually manage the system
- Technology change

Success Factors
- Understanding the requirements
- Integration into existing IT architecture
- Standardization of requirements
- Choosing the right application
- User involvement in system procurement
- Changed work process
- Strong leadership

Information Services Company

The information services company (ISC) described in this study repackages paper-based information into microfiche, microfilm, and CD-ROM

products. By indexing, cross referencing, and reordering various types of technical data, this firm provides four major data bases of information for resale: vendor catalogs, industry standards, federal standards, and military specifications.

The organization's DIS supports the production of these items, providing both revenue enhancements and production efficiencies. The Senior Manager for Microform and Electronic Imaging, a specialist in photographic science and instrumentation, detailed the firm's assimilation of its DIS.

Chronology of Events

In the late 1970s and early 1980s, while the firm was searching for a modern, cost cutting, and efficient way of producing its many products, it became aware of the emerging optical-disk technology. In 1984 the firm staffed its document imaging technology research and development (R&D) efforts. The Vice President for R&D assembled a team of computer, imaging, and information specialists to design a specialized DIS for production use. In 1985, when the technology appeared mature enough to provide possible benefits, the Vice President was given the go-ahead to procure the system.

During 1984-1985, the team designed the Electronic Product Build System (EPBS). It combined specially designed and custom-built imaging hardware and software with an Electronic Beam Recorder (EBR) which output electronic information onto microforms. In 1986 the EBR was the first piece of hardware procured; the rest of the system would have to be integrated with the EBR.

An RFP for imaging capabilities was released to 45 vendors in late 1985. With responses due only two and a half weeks later, some 22 vendors offered everything from mainframes, to bits and pieces of the system, to integration services. After the firm evaluated the responses and redefined the system, the vendors presented their products. The source selection committee visited 11 sites and determined that only one company, a firm with a working system and with prior experience, could provide what it needed. In 1987, Integrated Automation was chosen as system integrator and as provider of all imaging hardware and software.

At the vendor's site in April 1988, the vendor passed the factory acceptance test which tested hardware, software, and some applications. In August the equipment was installed at the ISC. Software followed in October; staffing occurred in November. The

new operation, which consisted of scanning and storing images for later retrieval and formation into a variety of documents, commenced in November.

Design of the system was an iterative process. The following example describes how the ISC adopted the image system to facilitate the production of one of their CD-ROM production lines. During the six months following the start of operations, the team's observations of the changes in storage technology refocused the scope of the work. It became apparent to them that, not only was the EPBS a way of gaining production efficiencies, it would also allow the firm to move into the production of CD-ROMs. In May 1989 the contract was modified to enable the DIS to send output at a much higher rate to a magnetic tape drive. The tapes would then be used as a master file for the production of CD-ROM products.

The modifications were installed in early July, and by the end of July it was operational. In November 1989 the first CD-ROM product was released. It contained 125,000 images and is updated and republished every 60 days.

A summary of key events is shown in Figure 6.

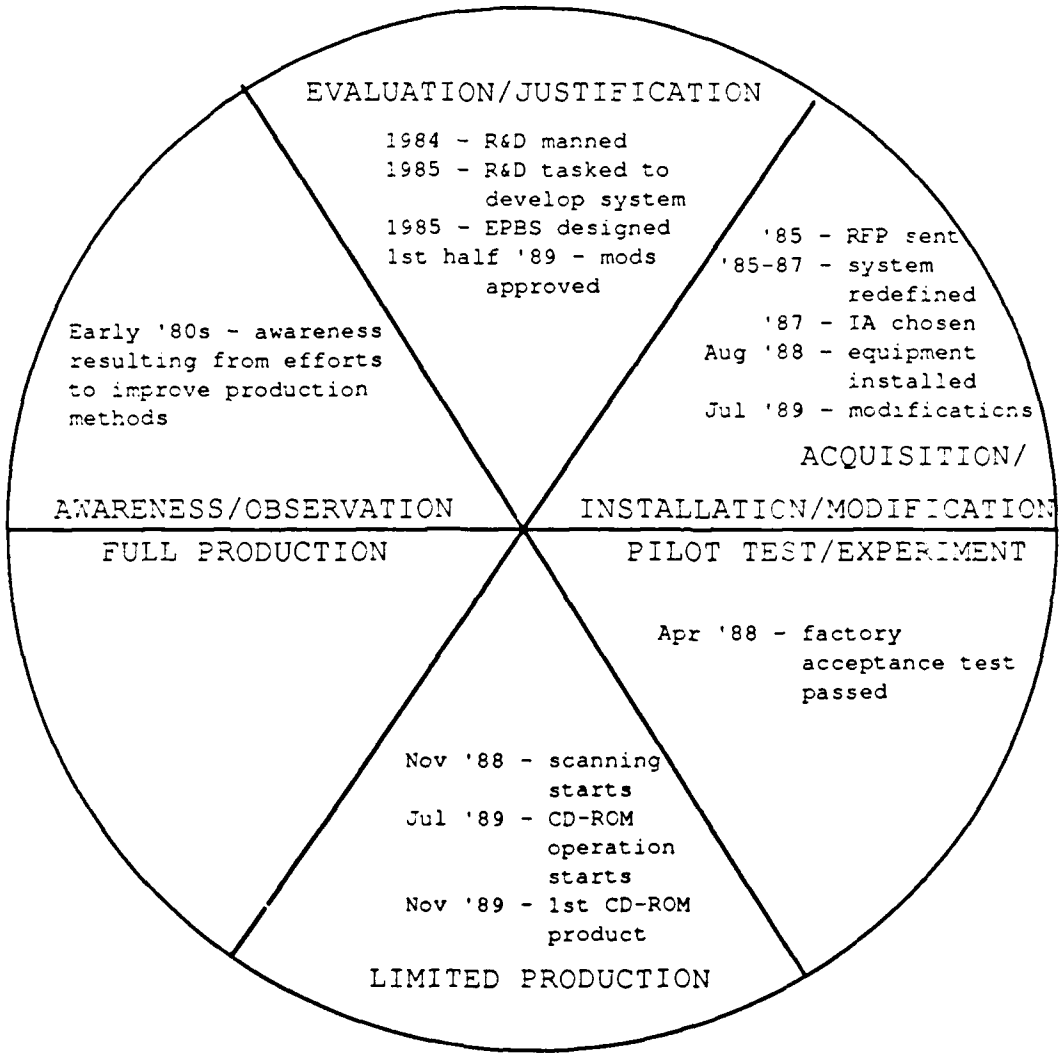

Figure 6. Stages of Technology Assimilation Model
Information Services Company

The Push for DIS

For almost thirty years the business had been manufacturing its data products on microform media. It had manually assembled the pages and then reproduced them using traditional photographic techniques. Its interest in document imaging technology stemmed from its efforts to find a more efficient way of producing its products, thereby maintaining technological currency and curbing costs.

Storage space for documents also contributed to push for imaging. The firm stored 13 million documents in its production facilities, occupying a tremendous amount of costly storage space.

The objectives for the DIS included a central database for its many images, an indexing system for easy access, and integration with the EBR.

The EPBS demanded changes in both input and output production methodologies. Input procedures were altered to include the scanning and inspecting of documents, writing images to disk, and indexing the page. The output process included the selection of images via a "pick list," the retrieval of images from the optical disk, and the ordering and writing of images to either magnetic tape or film.

Another criterion which the image system met was its ability to index images adequately. The system had to track which image was the latest version and in which documents the image was located. One image typically appeared in a variety of documents.

The Role of IS

The IS department played virtually no role in the imaging system. The production department owned and managed this stand-alone, turn-key system.

Perceived Benefits

This EPBS has become a critical part of the business. Some of its many benefits are highlighted below.

The system enabled the introduction of new CD-ROM products. Though CD-ROM production was not foreseen in the original procurement, it became an important revenue enhancement for the ISC. Subsequent to its first CD-ROM series, the firm released another data file containing 300,000 images and is currently producing a CD-ROM series containing 600,000. These new products generated increased revenues and a competitive advantage.

The imaging system accelerated its conventional microform production processes. Instead of manually

assembling paper images, the DIS provided them to the EBR where they were filmed in either microfilm or microfiche. Contributing factors included time compression, improved document distribution, and better access to documents.

Another benefit was the reduction of storage space.

Perceived Risks

The Senior Manager's primary concern for the EPBS is only having one EBR. The equipment's $500,000 price tag prohibits the firm from buying a back-up. As an alternative, the ISC contracted with the equipment's vendor, Image Graphics, Inc, to provide on-site maintenance.

Another risk was the continuing change in the technology. The Senior Manager moved to stay abreast of these changes through participation in user groups, direct contact with the vendor, and trips to the annual convention of the Association for Information and Image Management (AIIM). This convention includes a show by vendors and other participants in the electronic and traditional imaging industries.

Prospects for the Future

Though the role of the DIS is expected to increase, it has limited potential. It will be used to continue the firm's growth in the introduction of new CD-ROM products. A current technology upgrade will accelerate the system's capabilities to write to magnetic tape. Despite this and other upgrades, the Senior Manager did not foresee the role of the DIS moving into "traditional" DIS applications.

Evaluation of Implementation

The implementation succeeded for several reasons.

Clearly defined application. Having a clearly identified use made imaging technology more than a "solution looking for a problem." With definite goals in mind, the R&D team had clear objectives.

System definition process. The iterative process for defining the system and selecting the vendor seems to have given the company exactly what it needed. The team kept its objectives in focus, and yet, it showed flexibility in how to meet those objectives.

Cost Management. The system chosen had an expensive price tag. However, it was fully justified to

top management and approved in the firm's capital expenditure plan. Justification balanced predicted costs with manpower savings and other benefits, such as shortening time it would take to market new products.

Table 4 summarizes the key findings for the information services company.

Table 4

Key Findings for Information Services Company

Benefits
- New Products
- Reduced storage space
- Increased productivity
- Better document control
- Improved document access

Risks
- Only one EBR
- Changes in technology

Success Factors
- Clearly defined application
- Iterative system definition process
- Indexing capabilities
- Cost justification
- Change in work process

FINANCIAL SERVICES COMPANY

This organization provides travel and entertainment cards to both personal and corporate customers. It also helps its corporate clients to manage the travel expenses by tracking employees' credit charges.

The DIS became operational in 1987. It assists in tracking all mail inquiries and provides crucial work flow functions in the operations of the business. The interviewee, the Director of Corporate Technology, supervised the second major DIS implementation in the firm. His job included directing all non-mainframe automation efforts within the corporate group.

Chronology of Events

Prior to 1985, the company examined the way it had done business, looking for ways to improve its processing of credit card inquiries received via the mail. During 1985, the firm investigated document imaging technology and its vendor market, and in 1986 the company purchased a small scale system from FileNet. The firm determined that FileNet was the only vendor offering what the organization needed.

This pilot system was installed in the personal cards group where the organization tested its requirements. It sought a system which could provide work flow control for its employees and inventory control for its files.

After proving the system's abilities, the firm implemented its first operational system in 1987. This system consisted of 36 high resolution workstations, an Ethernet LAN, and a 64-disk jukebox. It took nine

months to develop the scripts (software) which controlled the document flow.

In 1988, the company acquired its second FileNet system; this one for its corporate customers. Building on its experience, the company again piloted a system to prove its objectives.

There were three objectives to be achieved by this pilot. First, the organization sought to measure the benefits in the corporate card environment and then afterwards build its business proposal. Second, the pilot platform was used to develop, modify, and test the software application. Finally, the pilot provided further exposure to more of the organization's members.

Things happened quickly during 1988. The firm installed the equipment in August; the software scripts for controlling the employees' processing and inventory control were developed in August and September; and the pilot ran from October through December. In January 1989, the business proposal was approved. On the sixth of February the second system, with its 44 newly installed terminals, was up and running.

A summary of key events is shown in Figure 7.

The Push for DIS

Prior to implementing its DIS, the customer service representatives started a paper file for each

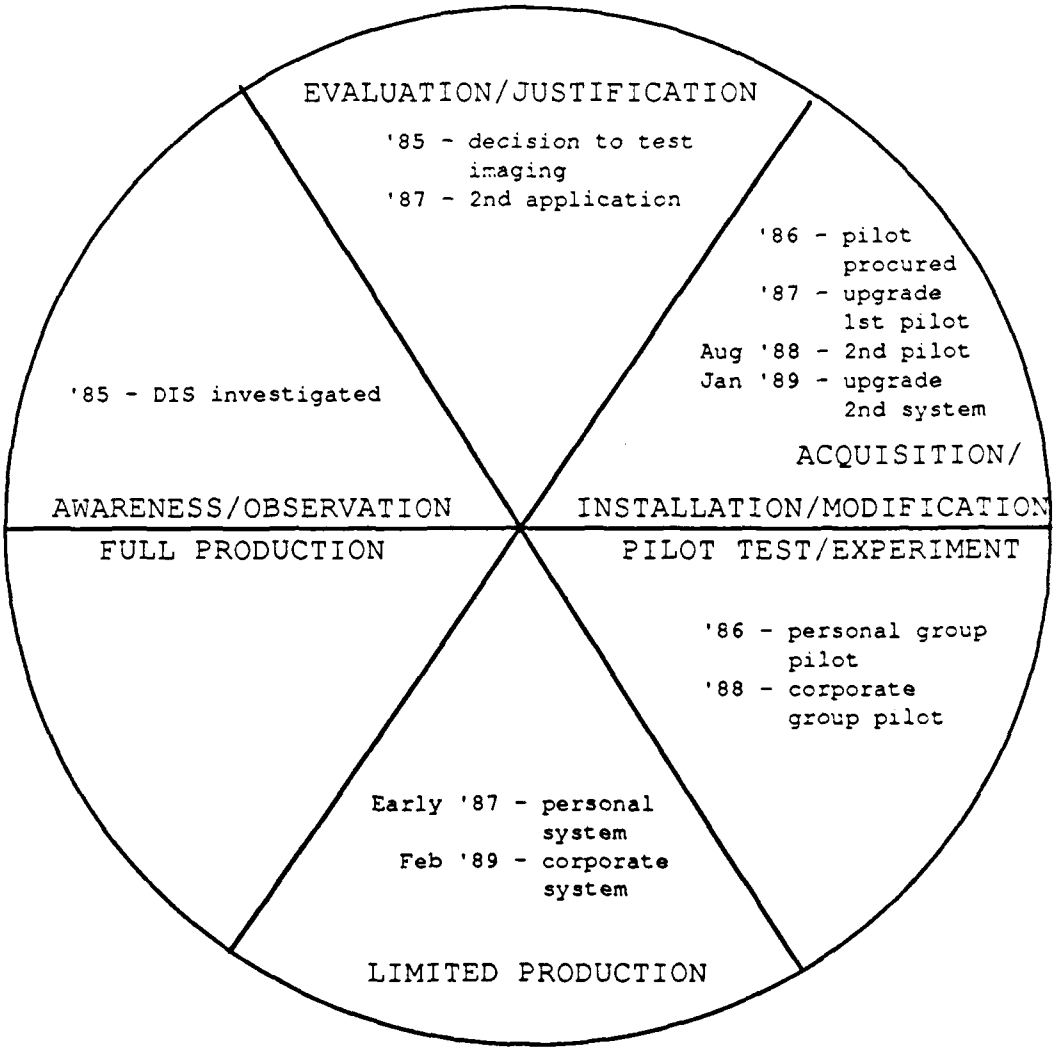

Figure 7. Stages of Technology Assimilation Model
Financial Services Company

mail inquiry. This file tracked the accumulating paperwork until it all had been collected, a decision concerning the inquiry had been made, and the customer notified. Ten thousand pieces of correspondence a month were received by the personal card group alone. This manual paperwork handling was inherently inefficient. Employees had to leave their desk to locate the file. Typically, on their way, time was spent talking to other employees. Employees spent additional time locating payment records on microfiche. Management felt many improvements could be made in the work process.

Legal requirements also drove up costs. Regulation Z, the consumer credit laws, imposed time requirements on the time credit card companies had in settling disputed bills. If these were not met, the credit card company had to write off the disputed amount. Often charges written off resulted from lost files and files which customer service representatives did not want to work because they were legally messy. The company had a significant amount of uncollected payments.

In specifying the system, the company pursued two main objectives. First, the system had to allow the firm to control the flow of documents within the

organization. This control would track the status of each query, log each piece of correspondence as it arrived in the mail, set dates for follow-up actions, and notify a representative when all documentation required for a decision had arrived.

Second, the firm wanted management reports which would allow it to monitor the system's performance. These reports would allow management to track work-load factors in detail and thus allow it to control inventory. Regulation Z time limits could also be tracked.

The Role of IS

The role of the IS department was limited. The organization's IS function was like many others in the industry--backed-up with many conventional application development and maintenance projects. Thus, the Corporate Technology Director managed the project with resources from within his department.

Perceived Benefits

This organization presented a clear vision of the benefits gained from imaging. Improved productivity, reduced costs, and improved customer service were clearly outlined as real benefits.

Productivity improved radically. Instead of spending time tracking down files, representatives studied and decided cases. In the first implementation, the staff was reduced by four people (through attrition), although more have been added as the company increased its volume customers. This latter increase represented a slower employee growth rate than that prior to DIS implementation.

Regulation Z losses decreased dramatically.

The quality of customer service improved. The turn-around time decreased. Letters contained fewer errors. Representatives no longer forgot actions because the work-flow control provided by the software sequenced the actions.

The system's first-in, first out (FIFO) programming also ensured that messy files were indeed worked. When a representative finished one case, the FIFO algorithm automatically retrieved the next available file.

A final benefit was the availability of both images and data on the same workstation screen. The terminal's emulation of an IBM 3270 device gave workers quick access to the organization's accounting computer. As a result, workers could view all the case-related documents and the activity on the account on one screen.

(This capability was achieved without increasing the backlog of work in the IS department!)

Perceived Risks

At the time of the study, the Director did not perceive much risk. The company had already fully implemented two applications and was in various stages of implementing others.

FileNet was a risky choice because in 1985 it was only nine months old. By the second implementation, however, FileNet had established itself as an industry leader in mid-size systems.

Prospects for the Future

There were two more applications mentioned by the Director. The first targeted the merchant side of the business; it was in the pilot stage. The accounts payable function was in the design stage. The Director was pleased with how they were proceeding.

The company was also interested in FileNet's PC-based system. Several customer service groups, whose representatives retrieve fewer than 150 records per month, could use this type of system.

Evaluation of Implementation

Many factors contributed to the continuing success of document imaging technology within this

organization. These included the overhaul of the business processes, employee education, user participation, and prior experience.

Overhauling its work design. The company deliberately sought an application which revolutionized the way it conducted business. In the words of the Director, the firm "looked to change." The designers observed how the workers were doing their jobs, examined how the jobs could be improved, and made job changes. Taking another step further, management changed the workers' habits. For example, workers used to wait until the last hour of the day to sign correspondence. After the system was implemented, they were still waiting for that last hour; that is, until management pointed out that the thirty seconds or so it took the DIS to update the files and fetch the next file could be used in signing letters.

Employee education. Employee education occurred at all levels. During the first implementation, the Vice President of Service Engineering (the "ATG" from the personal cards group) gave many "dog and pony shows" when advocating document imaging technology. FileNet T-shirts advertised the system in a less-formal way.

User interaction in design. The implementers met often with the pilot users. They discussed the good points as well as the hassles created by the scripts written by company employees. Changes followed.

Prior Experience. The company built on its successful first implementation. The corporate technology group borrowed a programmer from the personal card group to help write its scripts. These took only two months to develop compared with nine for the initial application.

Table 5 summarizes the key findings for the financial services company.

Table 5

Key Findings for Financial Services Company

Benefits
- Increased productivity
- Decreased costs
- Improved customer service
- Better document control

Risks
- Changes in technology

Success Factors
- Overhauling work process
- User interaction in the design of the DIS
- Prior experience in implementation
- Integration with mainframe
- Organization-wide DIS education

Telecommunications Company

This large firm provides telecommunications and telecommunications-related services in a multi-state area. At the time of the study, this firm operated numerous document imaging systems with more in various stages of assimilation. The Technical Director of Imaging Systems within the firm's ATG had been with the firm since its first image acquisition in 1985. His job included tracking the development of DIS technology, marketing the technology to the rest of the organization, and coordinating DIS implementations.

This case differs from the others by its lack of data chronicling the stages and the details of individual application assimilations. There were two reasons for this. First, the Director was wary about revealing too much information. Second, he limited the amount of time he would spend in the research. Nevertheless, this case was included because of the maturity level of the DIS technology within the firm. Thereby, it has the potential to reveal important critical success factors.

Chronology of Events

In 1985, the telecommunication company bought a image-oriented R&D subsidiary from an information

services company. The telecommunication company's management recognized its need to grapple with an increasing amount of technical and administrative documentation and "sensed intuitively" that imaging was the way to proceed. After examining the offerings of the emerging DIS industry, the telecommunications company acquired the R&D firm: its working document imaging system had precipitated the acquisition. (This prototype, a microcomputer-based technology utilizing low resolution monitor, is still used within the firm as a benchmark system.)

While some managers in the telecommunications company were impressed, many remained skeptical of document imaging technology. They challenged the group to develop a larger, jukebox-based system. The newly acquired group responded to the challenge and constructed a system capable of handling millions of images. However, this type of system was too complex and too expensive. As final proof of the technical feasibility of document imaging technology, the group developed a middle-of-the-road system, using microcomputers networked together. Scanning capabilities were 300 dpi; the monitors had EGA specifications.

The first operational imaging system entered the limited production stage in 1988. Five more have been implemented since that time. The last one became operational in May 1990. At the time of study 12 more applications were in development and two more were in the design phase.

A summary of key events is shown in Figure 8.

The Push for DIS

The need for imaging solutions became evident during litigations and subsequent negotiations with the government and other players in the telecommunications marketplace. The company's President and Vice President of Technology became keenly aware of the firm's need to better store and retrieve its legal documentation. The company had a huge data base of legal documentation; it was also generating 20,000 pages of legal documentation per week.

Additional factors favored document imaging technology. In the administrative area, the company needed to track documents on approximately 70,000 employees. In the technical arena, documentation for servicing and repairing the telecommunication systems in a multi-state area needed to be maintained easily. Finally, management needed to administer a large

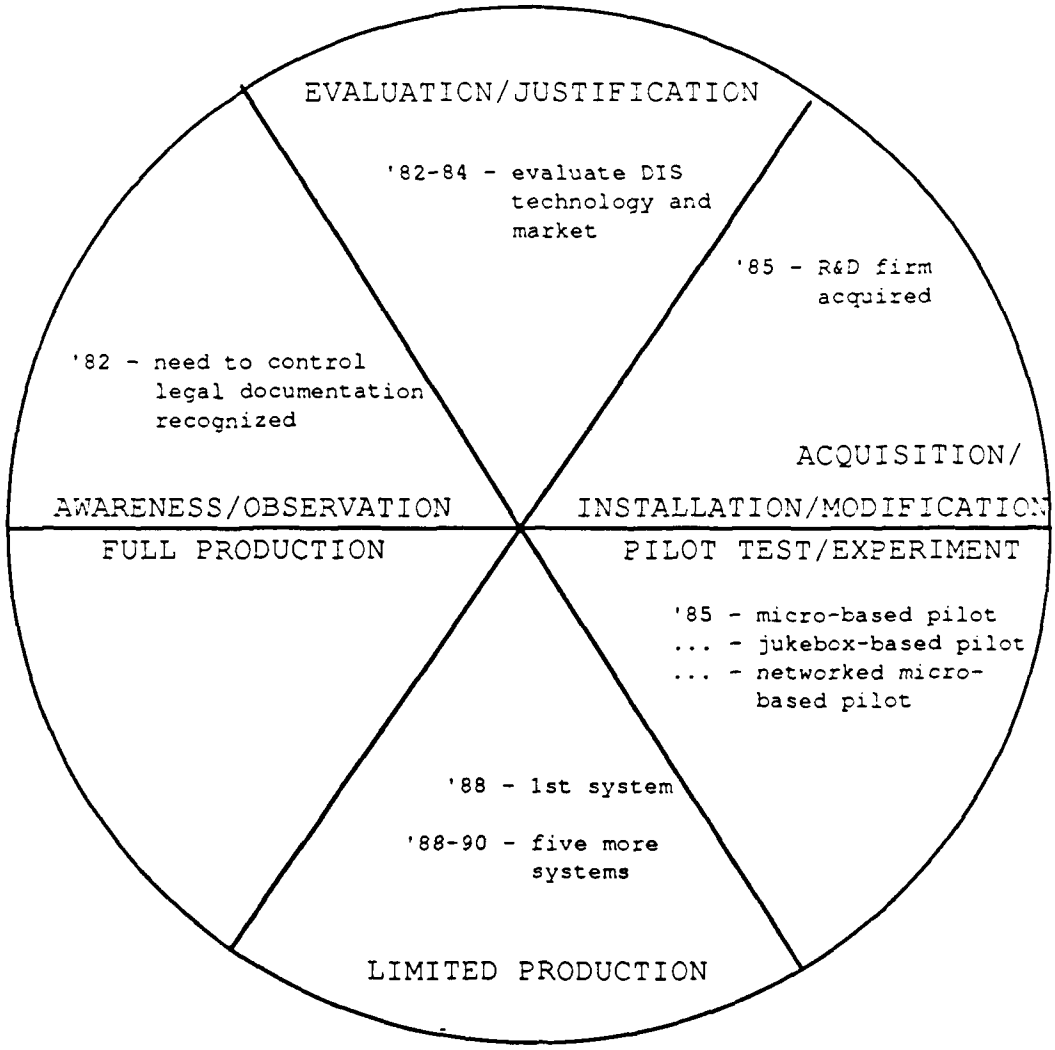

Figure 8. Stages of Technology Assimilation Model Telecommunications Company

customer data base in the multi-state area. These ingredients drove the telecommunications company to investigate and acquire its document imaging technologies.

However, managers within divisions and departments make their own decisions whether they implement technology. The decision proved to be complicated. For some, it was personally difficult. On one hand, they understood that the technology had the potential to reduce manpower costs. On the other hand, implementation would negatively affect the size of their "empire."

According to the Director, early managers struggled with the cost justification of the system. Those who implemented a DIS often refused to justify the system on a pure cost basis. To them, the rationale for implementing document imaging technology was more gut-level--they realized the hopelessness of the growing paperwork situation. The decision became more like that of purchasing a copier. The firm could save money if it didn't, but it was hard to do business without it.

Those who rejected this intuitive approach often failed to implement document imaging technology. They would not implement a new system without seeing

cost justification calculations. They wanted to see numbers before proceeding.

Two requirements were deemed essential to system acquisition or development. First, each proposed system must consider both the amount of time and the cost involved with conversion and indexing. For example, if the organization has 1 million pages to convert into images and it takes 10 seconds per page to capture and index, then the unit must allocate 1.3 person-years to that job. If there are 10 million images in the data base, this increases to 13.4 person-years. To figure costs, the unit must multiply person-years by the respective pay-rates.

The second factor considered in each acquisition was the user-interface. In the latest implementation, the system was installed on a Monday and users were operating effectively by Wednesday. Typically, the interfaces were tailored to the target group, whether to power-users, to novices, or to both.

The Role of IS

The role of the ATG and that of the top management was predominant in this implementation. The role of IS did not seem important at this level, though at the implementing level it may have been.

Perceived Benefits

Several benefits were cited by the director. The primary benefit was the elimination of lost documents. The DIS made tracking legal documents in a regulated environment efficient.

Document access improved with DIS implementation. Technical data was made more widely available to the technicians and others who needed it. Maintenance of those documents also became easier.

A third benefit was the reduction in storage space. Multiple copies of technical material were eliminated as they were stored on optical disks.

Perceived Risks

The primary perceived risk was an "erosive process" by which managers who refused to implement a DIS became hardened against implementing the technology. These managers did not see the need to change, and thus, each year their opinion hardened as they remain satisfied with business as normal.

Prospects for the Future

Though details were not forthcoming from the Director, the future of imaging technology for this organization appears to be promising. The firm is expanding the number of applications and improving its

technology. For example, it is researching methods to speed up the indexing process.

Evaluation of Implementation

Critical success factors identified in this study include the following:

Top management support. The top management demonstrated strong commitment to assimilating document imaging technology. This was demonstrated by the acquisition of the R&D firm early in the company's life cycle for imaging systems and their continued support for the technology.

User-orientation. The commitment to user-friendly interfaces helped ensure the systems' use. These interfaces made employees want to use the system; it also affected others. When employees saw how easy the system worked, more user demand was generated.

Cost Justification. The ATG developed a methodology which helped potential implementers evaluate imaging solutions by examining time and cost requirements. It also helped them determine the cost of not implementing a DIS in an environment where paperwork was growing.

Table 6 summarizes the key findings for the telecommunications company.

Table 6

Key Findings for Telecommunications Company

Benefits
- Increased productivity
- Better document control
- Improved document access
- Reduction in storage space

Risks
- "Erosive process"

Success Factors
- High level management support
- User-orientated interfaces
- Cost justification - flexible and traditional
- ATG involvement and promotion

Summary of Results

Table 7 summarizes the findings of the case studies. A "Yes" was recorded only if the interviewee volunteered the information or it was emphasized in additional documentation supplied by the interviewee.

TABLE 7

SUMMARY OF CASE STUDY FINDINGS

A First Air Force agency
B State government department
C Second Air Force agency
D Information services company
E Financial services company
F Telecommunications company

	A	**B**	**C**	**D**	**E**	**F**
Chronology						
Formal needs analysis	Yes	Yes	No	No	No	No
ATG Group	Yes	No	No	No	Yes	Yes
Demonstration	N/A	Yes	No	Yes	No	Yes
Pilot	N/A	No	Yes	No	Yes	No
Limited Production	N/A	N/A	89	89	87	88
Push for DIS						
Growing workload	Yes	Yes	No	No	Yes	Yes
Better customer service	No	Yes	No	No	No	No
Decreasing manpower	Yes	No	No	No	No	Yes
Business expenses	Yes	No	Yes	Yes	Yes	No
Document control	No	No	Yes	No	Yes	Yes
Legal requirements	No	No	Yes	No	Yes	Yes
Role of IS						
During implementation	Yes	Yes	Yes	No	No	No
After implementation	N/A	Yes	Yes	No	No	No
Perceived Benefits						
Better customer service	Yes	Yes	Yes	No	Yes	No
Increased productivity	Yes	Yes	Yes	Yes	Yes	Yes
Decreased costs	Yes	No	Yes	No	Yes	No
Better document control	No	No	Yes	Yes	Yes	Yes
Improved morale	No	No	Yes	No	No	No
Improved document access	No	No	No	Yes	No	Yes
New products	No	No	No	Yes	No	No
Reduced storage space	No	No	No	Yes	No	No
Perceived Risks						
Worker resistance	Yes	Yes	Yes	No	No	No
Business resistance	No	Yes	No	No	No	No
Continual management	No	No	Yes	No	No	No
Technology change	No	No	Yes	Yes	No	No
Weak links	No	No	No	Yes	No	No

TABLE 7 (continued)

	A	B	C	D	E	F
Prospects for the Future						
Commitment to expand	Yes	Yes	Yes	Yes	Yes	Yes
Evaluation of Implementation						
Rating*	Med	Med-Hi	Hi	Hi	Hi	Hi

* Ratings are made by the researcher.

CHAPTER VI

CASE STUDIES: ANALYSIS

This chapter examines and highlights the important actions taken by the participating organizations while implementing document imaging systems. Additionally, it compares their assimilation of imaging technology with the Brancheau model explained in chapter III.

Management Actions

The case studies are analyzed to identify a set of critical success factors which were used in implementing the imaging systems. The actions discussed below represent what was gleaned during the research. They are neither all-inclusive nor are they all relevant for each DIS implementation. The variety of uses for the technology, the benefits sought, the differences between the public and private sectors, and other organizational differences make it impossible to derive an all-inclusive set of critical success factors from this research. Table 8 summarizes these critical success factors.

Table 8

Summary of Common Critical Success Factors

Technology-Related Actions

Integration of the DIS into existing IT architecture

Design of adequate image distribution channels

Preparation for future changes in DIS technology

Operations-Related Actions

Implementation of adequate indexing procedures

Redesign of the work processes

Selection of the right applications

Organization-Related Actions

Identification of the roles of IS and/or ATG with respect to DIS

Breakdown of the knowledge barriers

Alleviation of user's fears

Involvement of users in the design process

Strong upper level support

Traditional and non-traditional cost justification methods

Technology-Related Actions

Management took several important actions to ensure that the systems employed were technologically adequate. They ensured both the integration of the system with their current information technology (IT) architecture and the design of adequate image distribution channels. They also prepared for more changes in DIS technology.

Integrating DIS into the existing IT architecture was an important consideration for four of the organizations. The state government agency needed integration with its minicomputer, which was used for general data processing functions. This integration allowed input into both systems to occur nearly simultaneously, saving processing time. The first Air Force agency will seek to utilize its existing broadband LAN to tie together the image system. It will use the various channels on the network to establish sub-LANs within the organization. The second Air Force agency mandated integration with its existing microcomputer-based technology as a way to reduce cost and simplify operations by limiting the number of terminals on desks. The financial services firm needed integration with the mainframe to allow workstations to access accounting functions. It used the imaging workstations' terminal-

emulation capability to give customer service representatives simultaneous access to both image and account files.

The only firm not interested in integration was the information services company. It needed a stand-alone, turn-key system for its production operations. Its only integration objective was to mate the document imaging technology with the EBR and magnetic tape recorder used in writing images.

The second concern on the technical side addressed adequate distribution channel size. The state agency, the financial services firm, and the information services company utilized dedicated networks to minimize image-access time. On the other hand, the second Air Force agency is utilizing its existing Ethernet LAN whereas the first Air Force agency plans to use its broadband LAN.

Several organizations took actions to help alleviate concerns for the future of DIS technology. The state government agency, hit hard by its bankrupt integrator, was able to secure support for continued applications development and hardware maintenance. The second Air Force agency strove to standardize its future requirements as much as possible, e.g., its specification of Group IV fax files as standards for its

image files. The Director at the financial services firm was involved with the FileNet users group to stay abreast of industry developments. The Senior Manager of the information services company tracked changes through vendor contacts and participation in AIIM conventions. Having invested significant amounts in their systems, these managers wanted to ensure their future viability and maintainability.

Operations-Related Actions

Implementers took several operational actions to ensure the success of their systems. These included implementation of adequate indexing procedures, redesigning the work processes, and choosing the right applications.

Having adequate indexing was important for three of the organizations. The state agency emphasized the importance of an exhaustive data base which was well-indexed. This ensured that the information its clients wanted could be found. The information services firm depended on its indexes to consolidate its different products. For example, the same page was included in both the vendor file and the design file. The second Air Force agency discovered the importance of indexing when its users, after becoming familiar with

the DIS, wanted new ways of accessing images. This was done through the implementation of new indexes.

All organizations changed the work process. By far, the financial services company had done the most work in this area. It aimed to make changes with the DIS, using the system's ability to control workflow through scripts. The information services company replaced its manual product assembly with its automated procedure using the "pick list." The state agency procured its DIS using a new business methodology specified in the RFP. Even the Deputy Chief in the Air Force organization yet to implement envisioned his customer service representatives with immediate access to information. The other agencies also changed their business processes but to a lesser extent.

Choosing the right application was another critical success factor. Some characteristics of the correct DIS applications include the handling and storing of many documents (telecommunications company, state agency, and information services company), complicated processing (financial services company), and the frequent accessing and retrieving of documents (the second Air Force agency and information services company). The potential application for the first Air Force agency, its retired-pay system, looked to be a

strong candidate with its expensive off-site record retrieval process.

Organization-Related Actions

Many of the actions observed in these case studies deal with organizational issues. These actions deal with the roles of IS and ATGs, user concerns, management support, and the justification process.

One of the most interesting findings concerned the role of the information systems group in the process of assimilation. In the three private firms, the role of IS was minimal. This paralleled experiences reported in the literature review. In both the telecommunications company and the financial services company it was the ATG in the organization which introduced the new technology and assisted in managing its implementation. It is typically the role of the ATG to explore, understand, evaluate, and test new technologies and analyze how they might be utilized within the organization to gain or maintain a competitive advantage. In the information services firm, the special R&D team along with the operations department was responsible. Contrary to the advice by John Connell cited earlier, IS managers in these organizations were not seeking to guide DIS technology.

The information systems group seemed too busy doing routine data processing.

It was different, however, for the three public organizations. The IS department took the lead in implementing document imaging technology and maintained it. In the state agency the IS group had written the computer systems plan and implemented it. In the first Air Force agency it was the operations chief who spearheaded the efforts, later giving it to the ATG (also under the IS department). It was only after the Deputy Chief had promulgated DIS-related information throughout the unit that the administration directorate and other functional areas started examining DIS for themselves. In the second Air Force agency the comptroller's IS chief championed the new technology, guided its assimilation, and maintained the system afterwards.

Implementers also took action to break the barrier caused by a lack of knowledge and experience with DIS technology. Implementers took actions to educate management. In the first Air Force agency the champion brought a functional area chief, a potential user, to investigate an operational DIS. He also circulated articles explaining the technology. In the telecommunications company and the financial services

company the respective ATG leaders intensely promoted the use of the systems.

Management actions to alleviate user fears were seen in five case studies. In one, the users' fears of being replaced were alleviated as managers refocused their justifications. In another, promises were made not to reduce manpower authorizations. Additionally, most of the organizations reported that users were given some training.

An important management action seemed to be in involving the users in various aspects of designing the system. In the financial services firm, for example, the users and implementers participated in "side-by-sides" which resulted in the redesign of workflows. In the telecommunications company the ATG emphasized developing system interfaces which targeted the user group. In the second Air Force agency, the mouse-driven system was not purchased because the users found it awkward switching between the mouse and keyboard.

Strong upper-level support was evidenced in several of the studies. In the state agency, the head of the department and legislators wanted to improve service to their constituents. This desire gave the Director of DP the strong backing he needed to implement the system. One organization's chief of information

technology responded to learning about DIS by creating an ATG. In the telecommunications company, top management pushed the efforts to acquire its original imaging capabilities.

The final success factor centered on the cost justification process. In these studies managers handled cost justification differently. In the telecommunications company, there were both intuitive and analytical procedures. In acquiring its initial capability, the firm relied heavily on what it felt was the potential of document imaging technology to help handle its out-of-control paperwork. Early implementers within the firm also leaned on their gut feeling concerning the technology's abilities. Later on, it developed its cost justification methodology, helping potential users to focus on the full cost of not implementing a DIS.

Other organizations, such as the second Air Force agency, the state government agency, the financial services organization,and the information services firm, used more traditional approaches. In these implementations, the systems were cost justified by increased productivity, manpower savings, cost avoidance, and bringing products to market more expeditiously.

Technology Assimilation Lessons

Constructing a stage-based model depicting the assimilation process for document imaging systems was another goal of this research. The assimilation experiences of the participating organizations, shown in Figures 3 through 8 of Chapter V, have already been charted using the Brancheau model as the framework.

Some of the items discussed below could well be critical success factors. However, since they fit better into the assimilation discussion, they have been included here instead.

Generally, the firms moved through the stages in a clockwise manner, starting in the Awareness/ Observation stage and moving to the Evaluation/ Justification stage. Organizations which implemented DIS then moved into the Acquisition/Installation stage. The first Air Force agency was still evaluating DIS applicability through its ATG. However, after the organizations acquired their initial DIS capability, their paths through the assimilation process separated. See Table 9 for a summary of how organizations moved through the stages of assimilation.

There were some interesting differences between implementations. There was some movement back and forth between the stages, especially between the pilot and

Table 9

Technology Assimilation Model Summary of Stages

A First Air Force agency
B State government department
C Second Air Force agency
D Information services company
E Financial services company
F Telecommunications company

1 Awareness/Observation
2 Evaluation/Justification
3 Acquisition/installation/Modification
4 Pilot Test/Experiment
5 Limited Production
6 Full Production

A	1-2
B	1-2-3-4
C	1-3-4-3-4-3-4-2-3-5
D	1-2-3-4-3-5-2-3-5
E	1-2-3-4-3-5-2-3-4-3-5
F	1-2-3-4-4-4-5*

* Indicates that the details for the 6 implementations were not disclosed

acquisition stages, and between the limited production stage and earlier stages. There were also skipped stages: for example, the second Air Force agency did not justify its system until it had become satisfied with its third pilot. Two other noteworthy observations included how organizations used their pilots and demonstrations and the methods used by firms in refining their requirements.

Use of pilot systems varied over the range of implementers. The second Air Force agency relied most heavily on pilots, testing three systems before becoming satisfied that Harris Lanier could cost effectively implement document imaging technology using the organization's existing LAN and microcomputers. Thus, the agency moved into the Acquisition stage from Pilot stage two times. It then jumped back to Evaluation/Justification stage in order to purchase the full scale DIS. After the integration of the expanded system into the LAN, the organization moved directly into Limited Production.

The financial agency's use of pilots proved to be the most interesting, moving from the Limited Production stage back to Evaluation, Acquisition, and then to Pilot stage. Not only did it pilot its first system, it bought a second pilot system from the same

vendor as the firm explored using DIS in its corporate cards group. Only after the second pilot had proven its objectives did the firm purchase its second full DIS. This unique methodology allowed the firm to develop the software on the pilot while not yet having invested money on the main system. Only after the application software was ready did it invest in equipment.

Both the state agency and the information services company used demonstrations, not pilots, to test the imaging technology. The state agency accepted the Plexus bid based on two factory demonstrations. It then spent over a year scanning in documents and testing the system's retrieval ability before it felt ready to enter into production. The information services company did not use pilots, depending instead upon the factory acceptance test at the vendor's sites to prove the system's functionality. This was possible because the system was to be used in a stand-alone environment. The production process was clearly defined.

The telecommunications company used prototypes to demonstrate the viability of document imaging technology to managers within the firm. Its pilots included the microcomputer-based system, the jukebox system, and a microcomputer-based networked system.

Firms also used the technology assimilation process to more fully understand and develop their requirements. For the second Air Force agency, the pilot systems allowed the implementers to weed out a non-user friendly system and a second system which would not integrate neatly into the organizations information technology architecture. The information services company utilized a cycle of system redefinitions based on vendor responses to the RFP to refine their requirements. Even after the vendor was selected, the contractor and company worked closely to refine the system further.

None of the firms had reached the full production stage, defined as the near-maximum expected use of the technology throughout the organization. The state government agency was about to enter the Limited Production stage while the other four organizations were already in the Limited Production stage. Nevertheless, the state agency had already targeted four new applications by this time. The second Air Force agency was in various stages of developing four new applications while simultaneously expanding and modifying the system. The information services company was not developing new applications, but instead, it

concentrated on new CD-ROM product development and hardware upgrades.

Two firms built on their prior imaging implementations to implement others successfully, spreading document imaging throughout their firms. The Corporate Director at the financial services company described two more applications as well as hardware upgrades. Bordering cn extreme optimism, the Technical Director at telecommunications company, with its six systems operating and 14 under development, predicted that document imaging technology could potentially be utilized by all 70,000 of its employees!

In conclusion, the data supported the Technology Assimilation model with firms generally moving through the stages toward Full Production. It also supported the assumption that firms could move back and forth between the stages, depending on the outcome of stage.

CHAPTER VII

SUMMARY AND CONCLUSION

Summary

The research accomplished in this thesis identified some of the critical management issues encountered in organizations assimilating document imaging technology. It reinforced the proposition that the choices managers make do matter when organizations are implementing new technologies, in this case, document imaging systems. Additionally, it provided strong support for the validity of Brancheau's Technology Assimilation model, affirming the assertion that firms often move back and forth through the various stages.

Factors identified in this research as key management actions which aided the successful implementation of a DIS included ensuring integration into the existing technical architecture, designing adequate image distribution channels, preparing for future technology changes, choosing the right applications to implement, selecting appropriate indexes, overhauling the work process, alleviating the

concerns of the users, securing adequate management support, and justifying the technology.

Suggested Research Improvements

Several steps could be taken to improve this research. These include increasing the depth of the case studies, increasing the number of case studies, focusing on one section of DIS users, selecting participants more systematically, and allowing more time for the field portion of the research.

The most important suggestion recommends researching each case study to a greater depth. This would lead to more authoritative analysis and conclusions. In the method utilized, only one interview with the person principally responsible for the DIS implementation formed the foundation of the research. In two cases, sparse supplemental documentation was provided. Since case studies can incorporate archival records, direct observations, and participant observation as well as interviews and documentation, these methods should be incorporated when possible. Additional interviews with other keys players and/or users could have contributed much to the study. These would allow the researcher to see and understand more

thoroughly the many sides of the multifaceted process of technology assimilation.

People are very busy; it was difficult enough to secure the achieved degree of industry participation. Nevertheless, if this research were repeated, it would be better accomplished using more in-depth interviews.

The need for more authoritative analysis and conclusions leads to a second suggested improvement--inclusion of more case studies. This proposed increase in case studies would allow the researcher to single out the more critical of the success factors.

However, it is also recognized that the researcher has to balance the depth of the case studies with the number of case studies, given the limited resources available. Since the researcher was primarily seeking "hows" and "whys," it is the judgment of the researcher, after doing this project, that the depth of research in this case should not be sacrificed to increase the number of studies. The number of studies should only be increased if there is a proportional increase in resources.

Another measure which should receive serious consideration would be to narrow the range of the technology explored. Document imaging technology can be classified according to size, from microcomputers to

mainframes; according to function, from production to operations; and according to industry, including the government, financial services, insurance companies, and others. Each of these could be used to isolate a set of comprehensive critical success factors.

Implementing a more systematic method for choosing participants could also improve the results. The selection through literature reviews, personal contacts, and contacting vendors "cold turkey" was effective in gaining participants but it lacked scientific methodology. The method used resulted in the study of two Air Force agencies and may have unknowingly introduced unwanted biases.

One very practical measure, and one well within the researcher's control, would be not to delay the start of the field portion of the research. Starting earlier would have allowed other organizations to participate. As it was, several organizations which would have participated and thereby enriched the research, were unable to join the study because summer vacations conflicted with the research schedule.

This is not to say that the literature review should have been delayed. It is crucial for the researcher to learn as much as possible from the literature. After the review, however, the novice

researcher finds himself in an unfamiliar situation, perhaps with "cold feet." This can result in unnecessary research delays. Externalities, such as family and job, may also cause delays. Therefore, if this study was done again, the field portion should not be delayed.

Future Research

Future research may build on this study in one of two ways. It may replicate the study and further isolate critical success factors, or it may investigate side issues which the study surfaced.

By replicating this study, and incorporating the suggestions noted above, more specific sets of critical success factors may be developed. If several types of implementers were studied, a matrix of success factors could be developed. For example, if implementations were divided according to DIS size, then each range of sizes might have its own set of critical success factors.

Additional benefits of replication would include currency of data and the potential for a life cycle of success factors. Since document imaging technology is continually improving, a set of static factors could well grow obsolete. Replication would

mean having current success factors based on the latest technology and management practices. Replication would also allow the tracking of critical success factors throughout the life cycle of the document imaging technology, as the organization builds upon its previous implementation lessons.

Pursuing related issues identified in this study forms another avenue of research. One such idea would be to study the role of the IS department in technology assimilation. This research noted the difference between the private and public sectors with respect to who led the assimilation endeavors. This study related how the three public organizations assimilated DIS technology predominantly through the efforts of the IS group, while in the three private firms, the IS groups were not more than remotely involved. Are the IS departments in the private sector generally too preoccupied with their daily duties to be cognizant of computer developments and how they might be used in their organization? Are IS groups in the public sector more open to pursuing technology innovations than the private counterparts, and if so why?

A related research topic would be to investigate if there is a correlation between IS implementations of the technology and the existence of

user resistance. In the three organizations wherein the IS group led the assimilation of the DIS, user resistance was noted. In those guided by the ATG or the R&D groups, user resistance was not noted. However, without further study, a relationship cannot be established or denied.

The third related question might explore the relationship between technology innovation and the lack of a profit motive in the public sectors. Are the functional areas in the public sectors too preoccupied with daily business, or are they too satisfied with business as normal to pursue economies offered by advanced technologies?

Conclusion

There are many barriers to overcome when implementing an emerging technology like document imaging systems. Management's actions need to be directed at removing those barriers, thus facilitating the assimilation process.

Researchers can study the implementations of early adopters, catalog management's actions, analyze those actions, and develop a data base of factors which can be used by others to aid in future assimilations. In doing so, researchers can assist organizations in

handling their information much more efficiently today than in the past.

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Appendix A

Emerging Technologies Project/Document Imaging Systems
(Date)

Name
Organization
Address
City, ST Zip

This letter confirms our interview scheduled for (date) @ (time) at your office. You'll also find an executive summary, the interview guide, and a survey designed to help measure the impact of Document Imaging Systems (DIS) in your organization.

The interview guide will help us gain an understanding of how DIS technology was introduced into your organization and the management activities which supported it. By examining these, we aim to understand the critical success factors for the use of DIS technology.

The survey on assimilation and organizational impact will be used to corroborate the results of the interviews. Please complete this survey; it should take about 15 minutes to complete.

You may omit any question. You may also withdraw from participation at any time.

All responses are strictly confidential. Names and other details will not be disclosed to anyone outside of the Emerging Technologies research program of the University of Colorado. Only summary results, will be available to the public.

I am looking forward to our interview. I really appreciate all your help. Please call Rick Brown if you have any questions regarding this survey or research project.

Richard Brown 467-9048
Research Coordinator

James C. Brancheau 492-5830
Project Director/Advisor

Appendix B

RESEARCH PROJECT
IMPLEMENTING DOCUMENT IMAGING TECHNOLOGY

EXECUTIVE SUMMARY

OVERVIEW

* The project consists of identifying the activities carried out by organizations during the introduction and implementation of image technologies and evaluating the success of these activities.

OBJECTIVE

* Image Technology replaces paper documents with digitized images of the original. This technology is quickly expanding into many organizations. By examining the disciplines utilized by implementing organizations, this study aims to specify the critical success factors required for effective use of image technology.

RESEARCH SAMPLE

* An in-depth look at a range of organizations which have implemented document imaging systems.

TIME AND RESEARCH REQUIREMENTS FOR PARTICIPANTS

* An interview will be conducted with the key personnel responsible for introducing image technology into the organization. This interview will take approximately one to two hours.
* A follow-up survey measures the organizational assimilation and impact of document imaging systems.

TIME FRAME

* Interviews and surveys are being conducted during June and July 1990. Research results will be available by August 1990.

CONFIDENTIALITY

* All survey and interview information provided by the organization and its employees will be held in the strictest confidence. Survey and interview responses will be kept confidential. Names and other details will not be disclosed to anyone outside of the research program of the University of Colorado.

POTENTIAL BENEFIT FOR PARTICIPANTS.

* Participating firms will receive a summary of the research results, enabling them to compare their experiences with those of other implementing organizations. Sharing this data could aid in further assimilation efforts.

Emerging Technologies Project,
Graduate School of Business Administration
University of Colorado, Boulder, CO 80309

Appendix C

Emerging Technologies Interview Guide
Document Imaging Systems

Name of Organization: _____
Date of Interview: _____

I. PERSONAL - RESPONDENT

Introduction; Discussion of research project and interview format.

* What is your current role in the company's use of document imaging systems (DIS)?
* When did you first become involved in your current job?

II. HISTORY OF ACQUISITION

* When did the organization or department first begin to study seriously DIS?
* Why did they become interested in DIS?
* Who was the primary motivator/champion? What was his/her position in the organization?
* Was there debate or controversy about investing in the new technology? If so, can you briefly describe the key issues?
* Were alternatives to document image processing considered? If so, which ones?
* What was the overriding factor(s) in deciding to proceed with the DIS?
* How was the system specified?
* What features were considered most important in DIS technology?
* How many products were considered?
* How was the introduction of the new technology managed?
* What was management's role throughout the acquisition?
* How were the users involved throughout the product introduction?
* Would you say that your initial expectations for the DIS have changed over the period of introduction and use? How?
* In your opinion, would the company make the same commitment today, knowing what they do now?

III. SUPPORT AND THE ROLE OF IS

* How was your organization's initial investigation into DIS funded?
* How is DIS currently funded?
* How will the system be funded in 2 years? 5 years?
* If the IS department was not the champion in the push for this technology, when, if ever, did it become involved? Describe its role.

IV. ISSUES

* What were the crucial technical issues involving implementing document image processing? How did you overcome them?
* How did the organization decide which applications to pilot? What about follow-on projects?
* How did business operations change with the implementation of document imaging?
* Was there a lack of organizational knowledge concerning DIS? If so, how did the organization deal with it?

V. PERCEIVED BENEFITS

* What would you say are the benefits your company has achieved through document imaging systems? The most important one?
* Have you experienced financial benefits from using the system?
* Do you expect to experience financial benefits in the next year? 2 years?
* Have you experienced efficiency benefits from using the system?
* Have you been able to provide improved customer service from using the system?
* Has document imaging processing reached its potential in your company? If not, what potential future applications and corresponding benefits do you foresee?

VI. PERCEIVED RISKS

* Are you concerned with the legality of image documents?
* Have there been problems with images crowding the networks and thereby reducing access time by the rest of the users?
* Have there been political or social issues within the organization attributed to the introduction of document image processing? If so, what are they?
* Are you concerned about the competition using DIS?

Appendix D

Organizational Use Of Document Imaging Systems (DIS)

(a measure of assimilation and technological impact)

In talking with other companies, we have found most follow a similar pattern when introducing new technology. They progress through stages such as those listed below. Please estimate the level at which DIS is used in your organization by circling the number of the stage which best describes the firm's current position.

1. Awareness/Observation
   Usually involves informal knowledge of DIS by key people within your organization.

2. Evaluation/Justification
   Usually involves spending time or money on formal analysis and may result in a "corporate" policy statement on DIS.

3. Acquisition/Installation/Modification
   Usually implies that DIS is under contract or development or it has been installed for technical modification and testing.

4. Pilot Test/Experiment
   Usually implies first business use of DIS.

5. Limited Production
   Usually implies some routine business use with more expected in the future.

6. Full Production
   Implies widespread routine use nearing the maximum use you expect for DIS.

If you have moved beyond the first stage, what were the critical success factors enabling movement into your current stage.

_____

_____

_____

Given the financial, political, and technical problems which can occur when introducing new technology, how easy was the firm's transition into the current stage?

Difficult 1 2 3 4 5 6 7 Easy

With respect to your firm's needs, do you see DIS as having further potential application? In other words, do you expect your firm to eventually move into full production with DIS?

Unlikely 1 2 3 4 5 6 7 Likely

If yes, what are the biggest obstacles to moving to the next stage toward full production?

_____

_____

_____

If you have reached the acquisition stage, which hardware and software are you using? Who supports it?

_____

_____

_____

Given the long-run maximum number of potential users in your organization, what percentage are using the technology today?

_____

Given the long-run diversity of potential applications in your firm, what percentage are implemented today?

_____

We also would like you to assess the impact DIS has had on your firm's overall effectiveness. For each factor listed below, rate the impact DIS has had on your organization by circling points on the scale below.

Impact of DIS							
1	2	3	4	5	6	7	Improved Productivity
1	2	3	4	5	6	7	Improved Customer Service
1	2	3	4	5	6	7	Elimination of Misplaced Documents
1	2	3	4	5	6	7	Reduction in storage space
1	2	3	4	5	6	7	Time Compression
1	2	3	4	5	6	7	Improved Document Distribution
1	2	3	4	5	6	7	Improved Document Flow
1	2	3	4	5	6	7	Improved Document Access
1	2	3	4	5	6	7	Competitive Advantage
1	2	3	4	5	6	7	Product Differentiation
1	2	3	4	5	6	7	Cost Reduction
1	2	3	4	5	6	7	Revenue Enhancement
1	2	3	4	5	6	7	Improved Readability of Archives

Your job title: _____

(for analysis purposes)

Thanks for your help. Please return to R. Brown, Emerging Technologies Project, Graduate School of Business Administration, University of Colorado, Boulder Co 80309. (303) 693-3739